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p. 66

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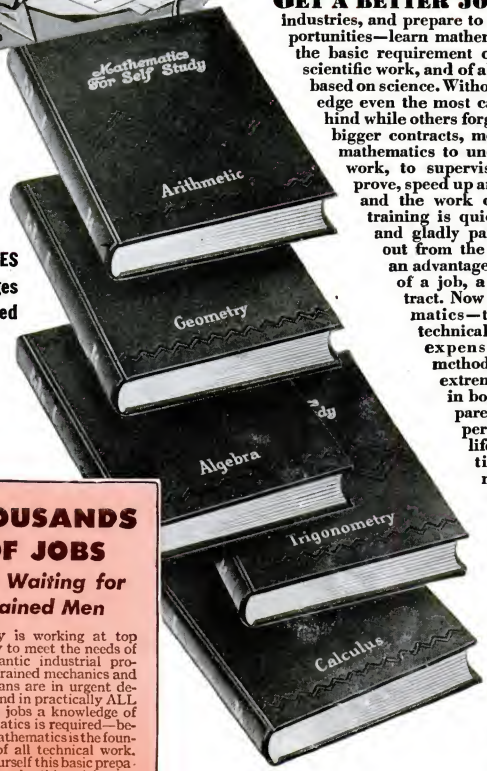


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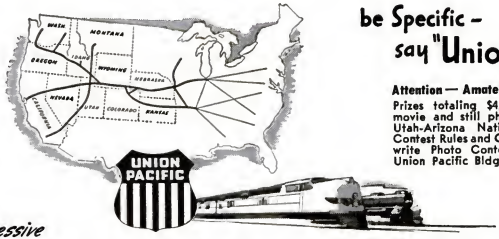


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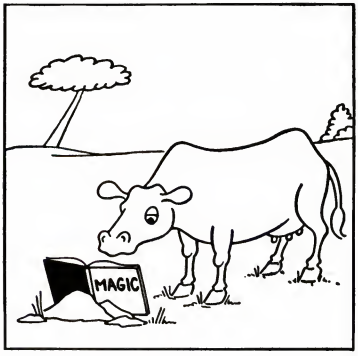

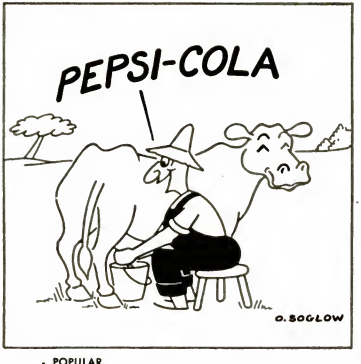


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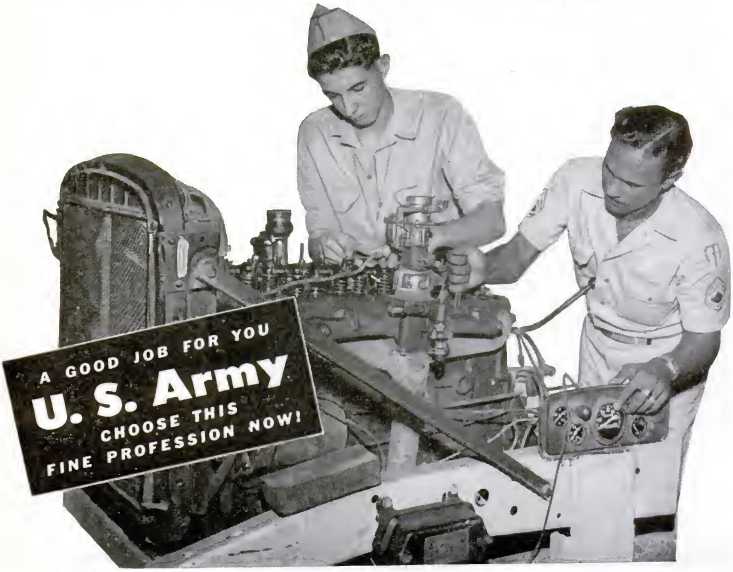

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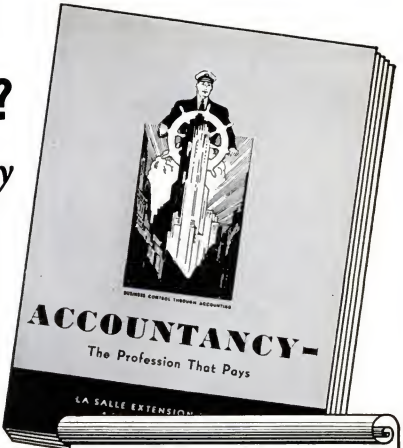


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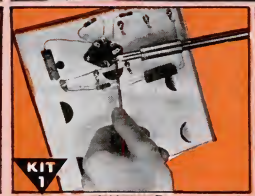


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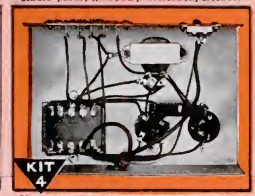
Early in my course I show you how to build this N.R.I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.

You get parts to build Radio Circuits; then test them; see how they work; learn how to design special circuits; how to locate and repair circuit defects.

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YOU wouldn't believe it, but I myself used to be a 97-lb. weakling. Fellows called me "Skinny." Girls snickered and made fun of me behind my back. I was a flop. THEN I discovered my marvelous new muscle-building system—"*Dynamic Tension.*" And it turned me into such a **complete** specimen of MANHOOD that today I hold the title "THE WORLD'S MOST PERFECTLY DEVELOPED MAN."

That's how I traded in my "bag of bones" for a barrel of muscle! And I felt so much better, so much **on top of the world** in my big, new, husky body, that I decided to devote my whole life to helping **other** fellows change themselves into "perfectly developed men."

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When you look in the mirror and see a healthy, husky, strapping fellow smiling back at you—then you'll be astounded at how **short** a time it takes "*Dynamic Tension*" to GET RESULTS!

"*Dynamic Tension*" is the easy, NATURAL method you can practice in the privacy of your own room—JUST 15 MINUTES EACH DAY—while your scrawny shoulder muscles begin to swell, ripple . . . those spindly arms and legs of yours bulge . . . and your whole body starts to feel "alive," full of zip and go!

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2,000,000 fellows, young and old, have already gambled a postage stamp to ask for my FREE book. They wanted to read and see for themselves how I'm building up scrawny bodies, and how I'm paring down fat, flabby ones—how I'm turning them into breath-taking human dynamos of pure MANPOWER.

Take just a few seconds NOW to fill in and mail the coupon at right, and you will receive at once my FREE book—"Everlasting Health and Strength" that PROVES with actual snap-shots what "*Dynamic Tension*" has done for others—what it can do for YOU! Address: CHARLES ATLAS, Dept. 1F, 115 East 23rd Street, New York 10, N. Y.

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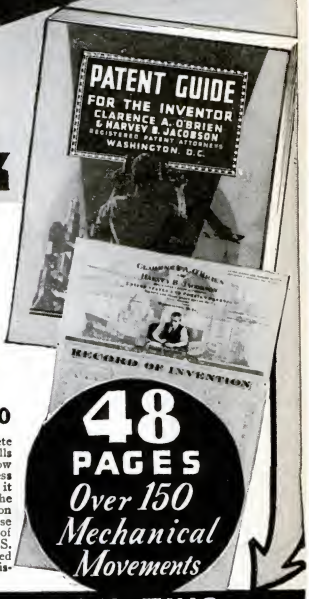


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# LETTERS

## About That Athodyd

Sir:

I noticed an article in a recent issue concerning the athodyd jet and its application to small planes. This article shows the jet placed in the tip of the propeller in conventional style. I have thought of a design which places these jets closer to the hub, in the form of an engine, in order to get more power for larger planes, etc. Placing them in this fashion allows these units to be added in decks of four or more, allowing the entire assembly to rotate inside of a jet cowl to drive the prop . . .

PAUL W. ORCHARD, JR.

New Orleans, La.

Sir:

With real respect to Inventor Fonberg and to your technical staff, a pair of items could stand comment. 1) "A compressorless jet, like the athodyd, is not self-starting." Mr. Fonberg's has a thermal compressor. Its loose, present design allows air intake to combustion over a wider range than usual—i. e., to start under little load. . . . 2) The jet does NOT *push* . . .

A. L. MURPHY

Trona, California

Sir:

. . . So it's the "push of the jet through the rear of the cone" that hurls the athodyd forward, is it?

HUBERT V. CARYELL, JR.

Toledo, O.

*Information on the athodyd may be obtained from Aircraft Jet and Rocket Corp., 949 East 29th St., Brooklyn 10, N. Y.*

*PSM blushes with its writer.*

## New Slant on Nova

Sir:

An astronomer recently reported an exploding star and speculated on the reason . . . I have that all figured out. Years ago that dark star was a planet sailing serenely along in a far-distant solar system. One of the inhabitants conceived the brilliant idea of constructing an atomic bomb . . . During his experiment he . . . blew his planet into kingdom come.

LEE MADDOX

Oaktown, Ind.

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BERNARD WEISSBOURD
Metallurgical Laboratory

Chicago, Ill.

*To that, PSM is dedicated.*

## Pictures That Tell Stories

Sir:

I'm a picture reader—I can understand any mechanism and working instructions by drawings or picture illustrations and Popular Science has always been noted for its illustrations.

W. B. REPERT

Dunkirk, N. Y.

*The Art Department gets up from its drawing boards to take a bow. Reader Repert might like to know that government bureaus, big companies, and teachers also appreciate working drawings that work—and use many PSM pictures.*

## A Venerable Idea

Sir:

In a recent issue of PSM, a New Yorker said that he would "like to see them make" an overpass truck.

It might be of interest to you and him to know that just such an idea, applied to trains passing each other on the same track, was patented by H. L. Simmons away back in 1895. The patent number is 536,360.

RAYMOND I. TOMPKINS

Richmond, Va.

## Index for PSM

Sir:

I'm wondering whether some kind of index booklet couldn't be published annually, giving the contents of the twelve previous issues. This would be a great help to those of us who use PSM for reference.

BOB BAUER

Kalamazoo, Mich.

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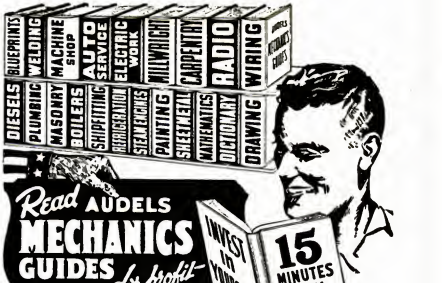


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J. F. VICTORY
Executive Secretary, National Advisory Committee for Aeronautics

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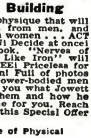

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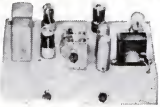

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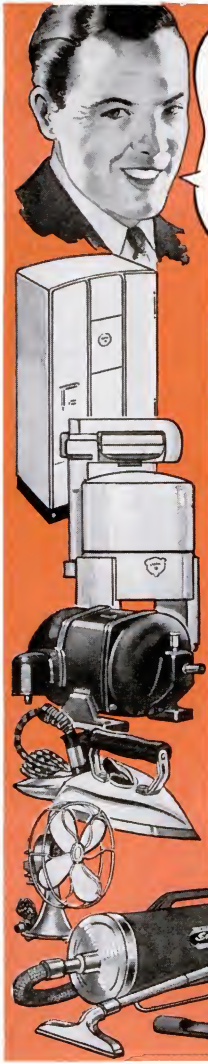

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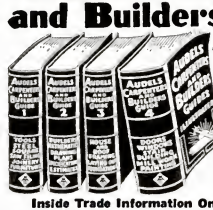


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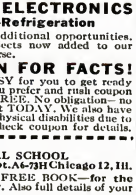

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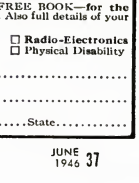

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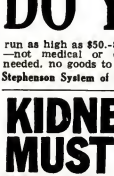

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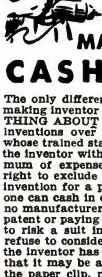

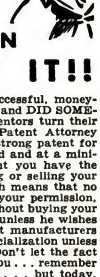

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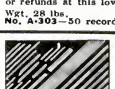


For your car, boat, furniture, etc. Highly polished chrome finished strips with clinched edges for flush mounting to any surface. The 3 pound kit provides approx. 43 pieces in lengths from 4 inches to 3 feet and ¼ to ¾ inches wide.
Wgt. 4 lbs.
*No. R-224—3 lb. Assort. only **$2.00**

### MESS KITS

Regulation Army Mess Kits. Ideal for campers, boy scouts, etc. Slightly used but guaranteed perfect. Two pieces. Folding handle.
A-116— Each..... **69c**

### GI POCKET BELTS

Of heavy canvas. Adjustable waist size. Each with 5 pockets and metal recoil fitting. Brand new. Fine for hunters, boy scouts, etc. Wgt. 3 lbs.
A107 **98c**

### 7-LB. EXPERIMENTERS PARTS ASSORT.

A "gold mine" for the radio serviceman. Hundreds of valuable radio parts, new radar and electronic parts and subassemblies, coils, resistors, screw machine parts, etc.—worth many times this low price.
A130R—7 LBS. **$1.79**

### CANTEENS, CUPS & COVERS

Regular U. S. Gov't issue canteens. Plastic screw top cap chained to body. Slightly used.
A117—METAL BODY. Each... **69c**
A118—PLASTIC BODY. Each..... **69c**
A109—Canteen Covers. New. Each..... **59c**
A119—Canteen Covers. Used. Each..... **35c**
A120—Canteen Cups. Used. Each..... **25c**

### MICROPHONE BUTTON

Brand new! For experiments in radio, electronics and other electrical apparatus. Used in telephone, amplifier and dictaphone work. Diameter 2⅛ inches. New.
A512—EACH..... **98c**

### PLASTICS—LUCITE AND PLEXIGLAS

In sheet form. Good workable sizes. Transparent. For costume jewelry, etc. Easy to work and polish. Shp. wgt. 6 lbs.
A280—5 LB. ASST..... **$4.75**

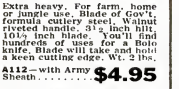
### CATALAN—ASST. COLORS

Extruded shapes, rounds, half rounds, etc. Easy to machine. Furnished in assorted colors, shapes and lengths. Shp. wgt. 6 lbs.
A281—5 LY. ASST..... **$4.75**

### AMMUNITION BOX

Fine for storing valuables, carrying lunches, etc. Of heavy gauge 7½x11x4 inches. Fireproof. Hinged lid with folding handle. Olive drab finish. Used, but perfect. Shipping wt. 4 lbs.
A525—EACH..... **25c**

### U.S. Govt. BOLO KNIFE



Extra heavy. For farm, home or jungle use. Blade of Gov't. formula cutlery steel. Walnut riveted handle. 3½ inch hilt. 10½ inch blade. You'll find hundreds of uses for a Bolo knife. Blade will take and hold a keen cutting edge. Wt. 2 lbs.
A112—with Army Sheath..... **$4.95**
A212—Leather Sheath, extra..... **$1.50**

### PUP TENTS

Regulation Army Pup Tents of durable, brown canvas. Used, but in good condition. Fine for campers, outdoorsmen, boy scouts, etc. Grand Xmas gift for children.
Wgt. 8 lbs.
A1—Tent Only.. **$3.95**
A110—Tent, new.. $7.95
A101—Ropes, wooden poles and stakes for above. Per set..... $1.00

### BIG SHIPS BELLS

Purchased from U. S. Maritime Comm. Measures 10 inches high, 9¾ inch flare. Big 6 inch clapper. Weight 15 lbs. Fine for farms, clubs, estates, etc. All new. Ship. wt. 16 lbs.
A541—ONLY..... **$9.85**

### CAVALRY SPURS

Genuine wishbone type cavalry spurs. Nickeled brass.
A102. Pair..... 98c
A103 Spur straps per set of four..... **50c**

### MEDICAL STERILIZER

Consists of alcohol burner and sterilizing tray in hinged metal case 1⅞ x 1⅛ x 2⅝ inches. Burner may be used separately. Bright nickel finish. All brand new.
A125—Each..... **98c**

### ARMY BANDOLEERS

Of fine heavy khaki. Has roomy pockets with snap button fasteners. Fine for hunters, campers, boy scouts, etc., also for shop work in carrying small parts, etc. Material alone is worth this price. Shp. wt. 1 lb.

11 Pocket Type No. 129 EACH **49c** | 5 Pocket Type No. 110 EACH **29c**

### ORDER DIRECT FROM THIS AD

Values galore! Hundreds of hard-to-find items for home, shop and outdoors. Make remittances by money-order, bank draft or personal check. Send 25% deposit on C.O.D. orders. No C.O.D.'s on orders for less than $5.00. Include sufficient postage on parcel-post orders—any overage will be promptly refunded. All quotations F.O.B. Chicago. Used items and materials are guaranteed serviceable and as described. Your money back if not more than satisfied.

**BIG ILLUSTRATED CATALOG FREE**

**STARK'S** Dept. PS546 509 So. State St. CHICAGO 5, ILL.

### STILLS

Distill your own water with one of these fine portable stills. Purchased from the Gov't. Completely self contained. Has 1 gallon capacity; output 11 gal. per hour. Fitted with genuine Coleman double burner stove. Operates 5 to 7 hrs. on one filling. Heat output 20,000 BTU's. Stove alone is worth this price. All new and guaranteed. Instr. included. Weight 100 lbs.
No. 206 Each... **$59.50**

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**Classified Ads only 50c per word per insertion, payable in advance. Minimum ad 10 words. To be included in July issue copy should be in our office by May 29th. July issue on sale July 1st.**

**POPULAR SCIENCE MONTHLY—351 FOURTH AVE.—NEW YORK CITY 10**

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DRUNKENNESS Is a disease which responds to treatment. Medical skill plus human sympathy prove successful with liquor and drug cases. 60 years experience. Write for free booklet. P. S. Nelson, The Keeley Institute, Dwight, Ill.

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UNLIMITED Opportunities Ahead! "How to Get a Better Job" may help your postwar planning. Information free. Joseph Weber, 5602 So. Francisco, Chicago 29, Ill.

STOP Cigarettes or Alcohol. Habit Broken Quickly, Pleasantly, Permanently. Through New Scientific Drugless Formula. Send $1.00. No other cost for complete instructions. Address: Psychogenic Science, Box 402, Canton 1, Ohio.

PERSONAL Adviser—Confidential, domestic, marital, educational, religious, general; by professionally trained, B.S., M.A., M.Ed., none less than $3.00, none more. Box #114, Gap, Pa.

TO The Sick: "Vitascience"—Drugless healing through the spoken word. Speak your ills away. Write for free details. Cedric S. Moore, 1313 S. Union, Kokomo, Indiana.

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FINKLE knows mailorder advertising! Nationally known writer guarantees powerful letters, literature, selling campaigns. Big, positive results! Postcards ignored. Finkle Advertising, 1201½ South Ogden, Los Angeles, 35, Cal.

ADVERTISE 24 words. 40 Newspapers $3.50. List Free. Advertising Bureau, 4515-P Cottage Grove, Chicago 15.

"HOW To Write Advertising," Absolutely Free! Dudley Bunn, 126-PS Lexington Ave., New York 16.

ADVERTISING Placed everywhere lowest rates. Reliable guidance on publications, expert assistance on ads without charge. Newspaper, magazine, mailing-list rate-book free. Chicago Advertising Agency, 20-MP West Jackson, Chicago 4.

ADVERTISING Service—For men going in business. Put our experience in merchandising and advertising back of your products. Write Van De Mark, 1107 Times Star Bldg., Cincinnati 2.

WHOLESALE: Blades, Aspirins, Laces, and others. Free Price List, Dempsey V. Neuniist II, 912 N. McLeansboro, Benton, Ill.

SPEEDY mailing, 500,000 classified names and addresses on stickers. Classified Personal Adv., 7 Chestnut St., Waterloo, N.Y.

24 WORDS in 64 Weeklies $4.96. J. Darnell, 730 Hays, Jackson, Tenn.

ADVERTISING. Poetic and rhyme form. Attractive. Number of rhymes unlimited. If interested write: S. Nye, 210 E. Union Ave., Bound Brook, N.J.

ADVERTISING: Placed in any publication, anywhere. Write for mail-order rate sheet "P". LeGrand Adv. Agcy., (Established 1923) Floral Park, N.Y.

TOP-Notch Advertising—free particulars. Productive Advertising Service, 852 E. 34th St., Brooklyn 10, N.Y.

GET—Advertising Tips on selling by mail. Contains Valuable Information, on mail order business, Price $1.00. A. H. Allen, 2335 Arapahoe St., Denver 5, Colorado.

SALES-Letters-Written. Master Copies $10.00. Box 5991, Cleveland, Ohio.

PROFITABLE Advertising in the South. Rate Bulletin Free! Alabama Advertising Agency, 216 Exchange Bldg., Birmingham 3, Ala.

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GOOD Paying Business Silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. G, Decatur, Illinois.

EXCELLENT Sideline for Printing Salesmen. Decalcomania Name Plates in small quantities. Also, make money applying Initials on Automobiles. Free Samples. "Raico", X-164, Boston (18), Mass.

FREE Water and our concentrates makes flavors, lotions, shampoos, 72 products, labels, bottles furnished. Qualco, F-20030 Russell, Detroit.

FREE! Latest issue Opportunity Magazine. Salesman's Guide, Inspiring, constructive. Shows how to earn money selling for others or in your own business. Hundreds postwar opportunities. Send name and describe what you have sold or are selling. Illustrated copy sent Free. Opportunity Magazine, 620 N. Michigan, Dept. 18, Chicago 11, Ill.

WAR Honor Scroll. All branches of service represented. 12 by 16. Space provided for name and photograph. Truly beautiful. Agents make big money. Sample 25c. E. Condon, Dept. 9, Upper Darby, Pa.

90c PROFIT each $1 sale. Sell permanent mothproofing solution to housewives, stores, agents. Experience unnecessary. Postal brings details. Kinford, Wayne 4, Penna.

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START Your Own Business on our capital. Always your own boss. Hundreds average $6,000 to $25,000 annual sales year after year. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world wide industry. Write Rawleigh Co., Dept. F-U-PSC, Freeport, Ill.

SELL Greeting Cards, Display Signs, Pictures, Books, Novelties. Big Profits. Bulletin Free. Elfco, 432 North Wells, Chicago 10.

AMAZING New Zipper Shoe sells on sight. Big profits for salesmen. Leads line 200 splendid styles. Territories open. Get Free Sample Outfit. Write Mason Shoe, Dept. M-339, Chippewa Falls, Wis.

GOLD Lacquered Window Sign Letters. New Foils—Styles—Absolutely Beautiful. Free Samples. Atlas, 7941 Halsted, Chicago.

FAMOUS Picture—four colors. 500,000 sold. Permanent opportunity. State experience. Sample print Free. Fine Flag Sales Corp., Dept. C-1064, Excelsior Springs, Mo.

NO Summer Slump in magazine sales! Make money year 'round taking new, renewal orders from neighbors, friends. Helps Furnished. Free catalog. Write McGregor Magazine Agency, Dept. PS-6, Mount Morris, Ill.

200 MONEY Making Deals, Plans, Rare formulas, Schemes. Folio Free. Formico Co., Box 572, Dayton, Ohio.

SELL, full, part time. Individualized belt buckles, tie holders, cap badges. Thousand emblems. Service plates. New lightning adding machines. Details. Hook-Fast, PS, Roanoke, Va.

MAKE cleanup selling perfumes, toiletries. Distributors' prices on request. Long profits. C. Behm Sales, 3635-J, Roosevelt, Chicago 24, Ill.

100% PROFIT on famous, popular Pines Birthday, Christmas, and all-occasion Greeting Cards. Wonderful 12 to 24 Card, boxed assortments sell on sight for $1.00. Write today for information and Extra Bonus Distributor's Plan. S. Pines, Box 32, Flushing, N. Y.

LUMINOUS pictures that glow in the dark. Large manufacturer wants factory representatives; wonderful new item; fast seller; free sample. Madison Mills, 303 Fourth Ave., N.Y.C.

SELL full, part time, Individualized belts, buckles, cap badges, tie holders. Thousand emblems. Every veteran prospect. Fast profits. Repeats. Write today special outfit offer. Hook-Fast, PS Box 1425, Providence, R. I.

CHRISTMAS Cards, Agents Wanted—21 DeLuxe Box Asst. Also 3 Box Assts. with name printed. A. B. Plateless Co., 392 Broadway, New York 13, N.Y.

IMMEDIATE Profits! Take orders for our new amazingly beautiful lifetime laminated Plastic Reproductions of any snapshot or negative. A genuine opportunity to build an interesting, profitable business without investment. Write now for details. Gotham Products Co., Dept. A, 215 E. 149th St., New York 51, N.Y.

HIGHEST Quality double edge blades. $1.35 per 100. Send 10c for sample pack. Peaberry Products Co., Dept. P.S. 524 Porter St., Phila. 48, Pa.

AVAILABLE exclusive territory. Distribute thru dealers Flasho, powder auto cleaner-polish. Particulars and sample free. Langdon Co., 4614 Prospect, Cleveland, Ohio.

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UP to $1.00 hr. plus grand prizes selling new silver polish. Requires no rubbing or polishing. Sells on sight. 25c coin brings pkg. and details. Mrs. Nickell, Rt. I, Box 456, Bend, Oregon.

AGENTS! Earn big money, selling personalized soap with names and designs that will not wash off. Sells on sight. Particulars free. The D. & P. Sales. P.O. Box 1471, Dept. M, Uniontown, Penna.

BIG bargains for big profits. Over 100 sensational values. Men's used suits $2.00, pants 35c, topcoats $1.25, overcoats $2.00, shoes 20c. Experience unnecessary. Free wholesale catalog. Superior, 1250-FA, Jefferson, Chicago 7.

PICTURES For Framing. Samples and Lists 10c. Curtis, Box 1916-B, Denver 1, Colorado.

SELL "Petite Picture Notes." Something really different in greeting cards. Sample free. Dunbar Cards, New Brunswick 2, N.J.

500 SALESMEN at once to sell Spa-Saver Clothes Rack $2.95 and plastic Changeceiver $4.50. Write for folders and price set-up. H. & H. Products Co., Arkansas City, Kansas.

FASCINATING year 'round income building plan. Take easy orders from friends, fellow workers, church oganizations for 10 fast selling greeting card assortment. Sell $1.00 each—cost you 50c up. Extra bonus. Experience unnecessary. Request foremost $1.00 All Occasion box on approval and free Correspondence Notes samples. Special Offer. Bluebird Studios, Dept. 17-H, Fitchburg, Mass.

SILVER Plating Liquid. Simply Rub-On with a cloth. Cleans. Silverplates. Polishes, one rubbing. Puts on genuine 1000 Fine silverplate. Renews silverplated ware like new. Silverplates onto brass, copper, bronze, etc. Lating finish, won't come off. Sales representatives wanted. Details free. NuProcess Products, Dept. 228, Aurora, Ill.

WE pay you $25 for selling fifty $1.00 assortments Birthday, All Occasion cards. Tremendous demand. Sell for $1.00—your profit 50c. It costs nothing to try. Write for samples. Cheerful Card Co., 174 White Plains, N.Y.

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BUILD Year Round Lifetime Business, sell everyday necessities to stores, institutions, industrial plants, homes, etc. Easy repeats. Excellent profits. Great cooperation. Become territory distributor. Investigate. Lytle Supply Co., Ave. 12, Fredericksburg, Ohio.

GREETING CARDS, Gift Wrappings, Correspondence Notes, Stationery, Novelties. 4154B Fifth St., Philadelphia 40.

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LUMINOUS Paint (Shines in Dark). Profitable seller to millions. Agents send 25c for profitable folio and Luminous color sample. Address, Lite-Saver, 97B, Saybrook, Conn.

AGENTS-Demonstrators, $150 a day possible. Embossum transforms handwriting into beautiful gold-silver raised lettering for cards, stationery. Cost 20c sells $1.00. Sample writing-literature 13c. Embossum kit 60c. Western Chemical, Salem, Oregon.

TREMENDOUS profits, history World War II, 1100 pages. Distributors, agents, jobbers wanted at once. Schlake. B127 E. Third, Cincinnati 2, Ohio.

AGENTS—300% profit selling gold colored window letters; stores and offices. Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

AGENTS—Big Money for Men, Women, boys, girls—selling gorgeous night-glowing Orchids, Gardenias; perfect imitation real flowers; last for years; all the rate for wear on hair or clothes. Write for wholesale prices. Marney's, Dept. S-1, P.O. Box 581, Ogden, Utah.

$3 FIRE Extinguisher sells wholesale or direct. "Fire Killer", Zone 1, Syracuse, New York.

SELL our effective Suntan Lotion during summer Tans without burn. Ideal sideline. Excellent profits. Bonny Fair, 53 State, Boston, Mass.

SALESMEN and dealers wanted for new fast selling household item. Nothing like it on the market. Send 25c for sample postpaid. F. R. Espling, Box 704, North Hollywood, Calif.

VETERANS $2 Brings 20-25c Toys & Self Selling Circulars. Clear $15 a day. Nick Hogan, 901 N. 15th St., Philadelphia, Pa.

BUILD permanent Income with Sure-fire Repeater. New Scientific treatment returns gray hair to natural color without dyes or capsules. Fills long felt want of thousands of men and women. Sold under money back guarantee. Liberal proposition to experienced sales representatives. Write quickly. Mayco Products Co., P.O. Drawer 4125-A, Orlando, Fla.

EASY Profitable Sales. Consumer, Retailer, Inexpensive Fire Extinguisher. Fi-Rout, Box 1154, Paterson, N.J.

EX-O-LENE! Most powerful gasoline stretcher! Easy sales! Big profits! Distributors wanted! Information free. Thermopowerful, Peoria 4, Illinois.

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WRITE today for prices on our Tonics, Herbs, Liniments, Ointments, Tablets, Soaps, Vitamins in Liquid or Tablet form; Anything and everything you need at lower prices. Celtonsa Medicine Co., 1016 Central Ave., Cincinnati 2, Ohio, Dept. P.S.

SELL Electric Testers—Neon Bulb, two needle point terminals tests Electric Irons, Toasters, Spark Plugs and Cables—Fuses, Armatures, Condensers, etc.—Radio Frequency, Grids, Circuits. Hundred Uses. Send 50c for Sample—One dozen on handsome display card $3.60. Gulf Sales Co., 226 Carondelet St., New Orleans 12, La.

$1.00 BRINGS $5.00 to $25.00 clear profit. New kind concentrated merchandise and coupon deal. Write Kohnn, 506 W. 45th, Chicago 9.

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HARMONICAS $10.80, $19.80 dozen. Harmonica Wholesales, 11 E. Centre Street, Baltimore 2, Md.

WONDER Silver Plating Liquid. Applied with cloth. Deposits permanent silverplate on all silverware, brass, bronze, zinc etc. Good carded item for stores. Wonderful demonstration. Big Profits. Full details by mail. Wonder Products, 1265A Broadway, New York 1, N. Y.

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DEALERS and Installation men to sell and install gas conversion burners. Large profits. Peerless 4320, Sheridan, Lincoln 6, Nebr.

HEATING Equipment gas and oil burners, furnaces. Reliance, Box 122, Lincoln 6, Neb.

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BUY unpainted plaques, statuary, etc. Decorate; sell locally. Good profits. Small cost. List free. Artists' brushes, paints, instruction books available. Pioneer, Box 394-PS6, Austin, Minnesota.

BIG Illustrated Catalog. Guns, swords, Japanese and Nazi Relics, cartridges. 50c. Bellport Gun Shop, Dept. A, Bellport, N.Y.

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441 ANTIQUE Firearms: 5,000 Bargains: Rifles, Coins, Fossils, Indian Relics, Carbines, Cartridges, Minerals, Antiques, Catalog #10 with Photographs, 25c. Heike, Wenona, Ill.

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FREE! 3 Questions Answered with Solar Horoscope. Send birthdate 25c. Professor Golliday, L-1514 Long, Columbus, Ohio.

COMPLETE Astrological Horoscope sent daily for one year—$2.00 (bills). B. Morgan, M.A., 8801 Grand River, Detroit 4, Mich.

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BIG Profits Manufacture custom arch supports. Julis Corssen, 2638 Geyer, St. Louis 4, Mo.

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RACING Car performance for all cars. Increase power, speed, pick-up. Special "Custom-built" equipment. Write Lee Motorcraft, 1412-B Great Northern Bldg., Chicago 4, Ill.

AUTOMOBILE Racing Book. Fifth Edition—Revised. Tells how to build dirt track bodies, frames, engines. Records, superchargers, rules, formula, plans, stock conversions, roadster racing, fast Fords. $1.00 postpaid; $1.15 C.O.D. Ray Kuns, Department 274, Madisonville, Cincinnati, Ohio.

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BUILD speedy Midget track racer from castoff parts! Plans, specifications, construction information, $1.00. Motor Supply, Box 1682-CS, Toledo, Ohio.

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AUTOCAR, English Automobile Magazine. Interesting advertisements, articles on foreign cars. Sample copy 50c postpaid. Clymer, Dept. B64, 2125 W. Pico, Los Angeles 6, Calif.

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HAVING Car Trouble? New, Used, guaranteed auto, truck parts save money. Transmission specialists. Describe needs; immediate reply. Victory, 2930¼ No. Western, Chicago 18.

BUG Screens:—For Car, Truck or Tractor. Prewar Made. Highest Quality. State Make, Year Model. $1.25 value. 50c each. Postpaid. Allen Co., Clinton, Mo.

AIR Compressor outfits, complete with quart size spray guns, less motors. Use your own ¼ Horse Power Motor. Limited Quantity. Write for details. Box 172, North End Station, Detroit 2, Michigan.

GRILLES for most all cars. Meyers Auto Parts, 820 Dryades, New Orleans, La.

AUTO parts for all autos and trucks. Trans. motors, differentials, fenders, carburetors. Also Body Parts. Security Auto and Truck Parts, 1941 BP Eddy, Chicago 13.

MUFFLER manual. Convert easily to Hollywood, Laguna, Westwood, duals, etc. Includes construction details, regulations, diagrams. Postpaid $1. Meliotone, Box 723C, Arcadia, Calif.

NOW, Water-Vapor injection. More power. Eliminates knock, carbon etc. Installs 10 minutes. $2.50. Rad-Ar Products, 140-27 169 St., Springfield Gardens, L. I.

PRE-WAR truck tubes most without repairs. All sizes at O.P.A. ceiling. Money-back guarantee. Tire Shop, 120 Orange Ave., Suffern, New York.

MAXIMUM performance economy, proper heat range, spark plugs, all engines except aircraft, 45 cents each prepaid. State make, model, thread size, fuel used, refund guarantee. Sparky, Box 1522, Jackson, Miss.

CARBURETOR repair kits for most popular cars. State year, make, model, carburetor, for particulars. Carburetor Service, 600-B LaPrairie, Ferndale 20, Mich.

1000 MOTORISTS Needed to make gas saving test. Up to 30% savings. For trial test offer write Vacu-matic Carburetor Co., 7617-1280 W. State St., Wauwatosa, Wis.

OIL Pumping Motors—Brought Back to Normal without Ring Job. Write for Particulars. Joe Mullner, Box 3102, I, St. Paul, Minn.

SURPLUS reliable used tires guaranteed repairs. O.P.A. Ceiling 600 x 16 $6.65, 650 x 16 $8.05, 700 x 16 $9.15, 750 x 16 $11.60. 1-piece quality tire reliners all passenger sizes below ceiling $2.00. Pre-War used passenger tubes all sizes water-tested $1.50. Tire Shop, 120 Orange Ave., Suffern, N.Y.

## 14 AUTO TRAILERS

BUILD your own Trailer! Save Money! Have every feature you want! Plans for House, Sport, Camp and Utility trailers. Catalog describing 9 models 10c. (15c in Canada and overseas) Jim Dandy, Box 125-B, Wausau, Wisconsin.

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AIRPLANES, gliders, crackups, located everywhere, some probably near you. Send 25c for Directory, giving owner's price, name and address. (35c by first class mail). Used Aircraft Directory, Athens, Ohio.

WIND Direction Indicator, Remote Indicating, Electrically operated, Airport, Recreation or Club. Morse Engineering Co., Fullerton Bldg., St. Louis 1, Mo.

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AERONAUTICAL engineers will give expert help on amateur or professional problems. Aero Lab, Box 342, Los Altos, Cal.

JET Propulsion Experiments. Now Principle to drive boats, bicycles, model helicopters. Circular on plans. Rush name. Houston Maupin, Tipp City 54, Ohio.

JET Propulsion Enthusiasts! It's here! Rocket propulsion for models. Tested! Proven! Not theoretical! Booklet with complete plans, instructions, etc. Card brings free particulars. Marwood Co., 3033 E. 92, Seattle 5, Wash.

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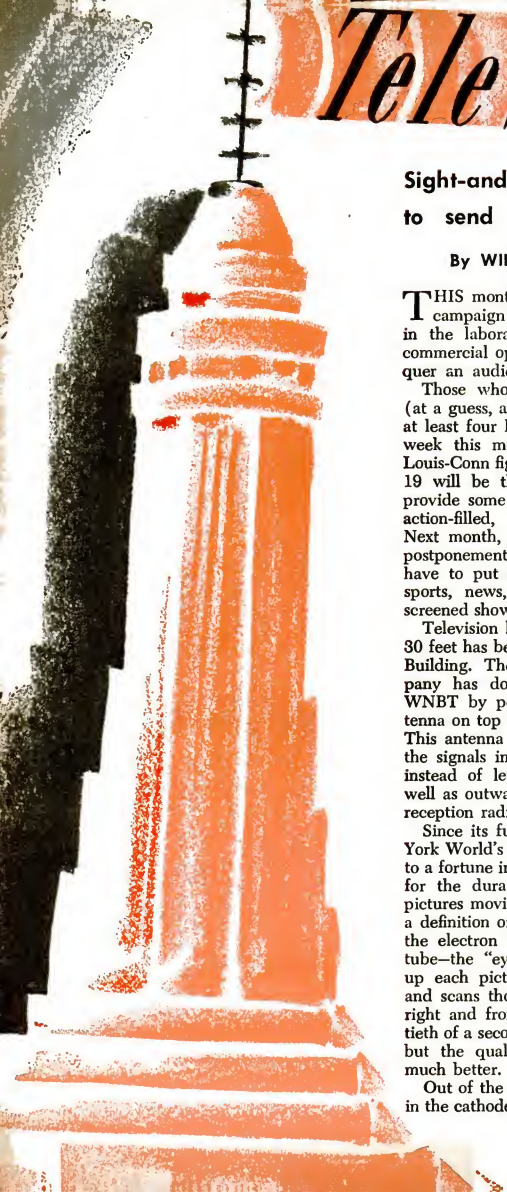
POPULAR SCIENCE MONTHLY
JUNE 1946

## *Thunderbolt at Work*

IN GENERAL ELECTRIC'S High Voltage Laboratories, at Pittsfield, Mass., lightning crashes across 30-foot gaps to test FM radio sets under thunder-shower reception.

Man-made lightning—up to 10,000,000 volts—is created when capacitors, each storing 100,000 volts, are stacked in two groups several feet apart, fully charged, and then short-circuited.



# Television

## Sight-and-sound broadcasters to send more and brighter

By WILLIAM P. VOGEL, JR.

THIS month television starts its postwar campaign for public acclaim. After years in the laboratory and months of limited commercial operation, it is now out to conquer an audience.

Those who already own television sets (at a guess, about 10,000 families) will get at least four hours of sight-and-sound each week this month. The televising of the Louis-Conn fight at Yankee Stadium on June 19 will be the stellar event; boxing will provide some of television's most compact, action-filled, suspense-crammed programs. Next month, unless FCC grants a further postponement, every commercial station will have to put at least 28 hours a week of sports, news, special events and live or screened shows on the air to hold its license.

Television holds such promise today that 30 feet has been added to the Empire State Building. The National Broadcasting Company has doubled the power of Station WNBT by perching a new and taller antenna on top of the world's tallest building. This antenna is so designed that it flattens the signals in the direction of the horizon instead of letting them squirt upward as well as outward, and thereby increases the reception radius from 60 to 70 miles.

Since its fumbling start during the New York World's Fair, television has fallen heir to a fortune in radar research. When frozen for the duration, it was standardized on pictures moving 30 frames per second with a definition of 525 lines. (This means that the electron beam in a television pick-up tube—the "eye" that sees the image—cuts up each picture into 525 horizontal lines and scans those lines, moving from left to right and from top to bottom, in one-thirtieth of a second.) This is still the standard, but the quality of television has become much better.

Out of the war came huge improvements in the cathode-ray tube, which produces the

# reaches out

## pictures to bigger audience.

received image. The glass was made with better optical qualities; its curvature was lessened, so that when viewed sideways the image would not be distorted like a reflection in a Coney Island mirror. The phosphors—chemicals that blaze into light when bombarded by electrons—were changed to double and triple the brightness of the picture.

In a new RCA cathode-ray tube, soon to be mass-produced, a microscopic film of aluminum, about four-millionths of an inch thick, is ingeniously deposited on the inside of the phosphor coating. The electrons pass through it, striking the phosphors and converting the television image into light. But the light, mirrored by the aluminum film, cannot go back into the tube. In uncoated tubes, the light loss inside runs as high as 50 to 60 percent; in the new tube the light is all projected outward. Increased voltages, 12,000 to 15,000 instead of 7,500, also produce brighter pictures. Even at these voltages, however, there is no danger from shock, because the current is measured in microamperes—just about what you generate when you scuff your foot on a thick rug in a cold room.

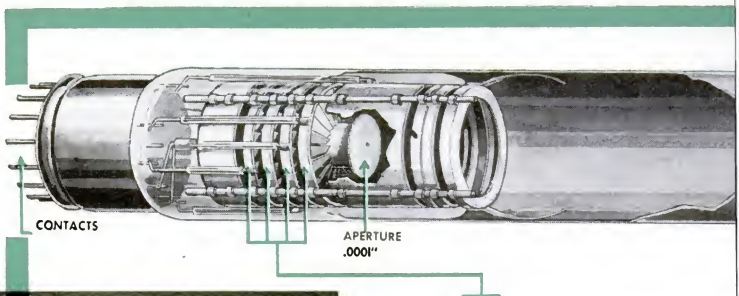
In a television picture with more light, more tones of gray can be crowded in. Prewar television had a contrast ratio of about 15 to 1, but soon contrast will be as good as in the average movie screen (40 to 1)—possibly even better.

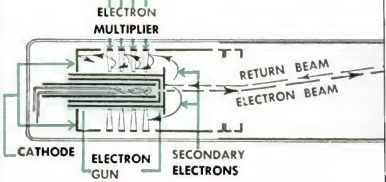
You will be able to see television pictures in roughly three different grades, depending upon the cost of the set. Probably the most popular grade will be the cheapest (estimate: $150 to $250), which will feature small cathode-ray tubes, say five or seven inches in diameter, and produce pictures 3 by 4 or 4½ by 6. Sets in the next price bracket will have cathode-ray tubes up to 12 or 15 inches across. In the highest price range you will see pictures on 20-inch tubes, and projected television in which an intensely bright high-voltage tube sends its image through lenses onto a ground glass the size of a home movie screen.

Sports events, long popular with television audiences, will have large share of coming 28-hour-a-week programs.

Persons accustomed to good radio reception with skimpy antennas will have to be re-educated for television; good antennas will be needed regardless of the quality of sets. The weakness of signals 40 to 60 miles from the stations will necessitate good antennas in suburban areas; and in cities, where signals are stronger, good antennas will be needed to get clear pictures free from ghosts—those troublesome multipath images that make a television screen look like a double exposure. Ghosts, created by reflected signals, are annoying—especially when they make an otherwise nice-looking actress appear to have four arms, two mouths, and several extra eyes and ears—but we must be grateful to them, even so, for they are the basis of radar.

Sight-and-sound has been assigned channels in the short-wave band from 44 to 216 megacycles. The shorter the radio wave, the more like light it behaves. Television waves can be aimed by transmitting an-





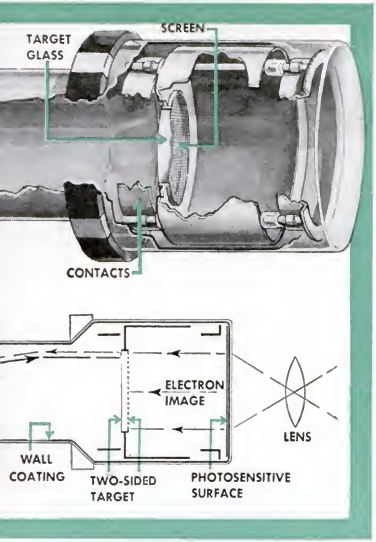

The Image Orthicon (rear) is really three historic tubes in one: iconoscope (center), perfected in 1930; image tube (left), 1935; and electron multiplier (right), 1938.

tennas very much as light waves are aimed by searchlights. And they can be reflected by buildings, trees and even airplanes. In general, radio waves begin to be capable of reflection when they are smaller than objects in their path. That is why the waves used in sound broadcasting do not bounce and ricochet—for they are far larger than almost anything they encounter.

Antennas for the public will most likely be dipoles—tall vertical standards with two horizontal pick-up rods measuring about nine feet across. The dipole should be installed at right angles to the line of transmission, so that the spread of the antenna is broadside to the television station. It should be carefully rotated to find the exact azimuthal setting that produces ghost-free reception. There may be several such settings—and there may be none. In the latter case, the set owner is out of luck, for at the present state of television development a rotating antenna is the only means of eliminating ghosts. The lead-in from the aerial to the set is also important. It will probably be a matched or twisted pair of wires specially designed to keep down loss of the signal. The trick in television lead-ins is to have the two wires a certain distance apart and to keep them always at that distance lest the signal vanish.

The broadcasters are also having their troubles. Most cameras and transmitter rigs now in use need rebuilding or total replacement. New equipment has been held up by the slow pace of reconversion. Studios need enlargement, but building materials are scarce. Broadcasters may not get them at all, because of a recent government order curtailing commercial construction in favor of the veterans' housing program.

Since television can be received only in




**The new Image Orthicon tube registers the television image on a photosensitive surface. The image then is carried electronically to a target and scanned. No matter how faint the light (and consequently the electronic image), the electron beam scanning the target can pick up the image. Below: The electron beam returning from the target is made to toss out secondary electrons from a small metal disk at the back of the tube. These electrons pass through multipliers, like tiny steam-turbine wheels, and are stepped up in each stage from three to five times. Thus the signal is amplified as it leaves tube and enters transmitter.**

line-of-sight transmission, approximately as far as the horizon, rural dwellers will not be able to gather around a 'scope for an evening's entertainment until networks are established. Because television wave-lengths are too short to be carried on the usual telephone circuits that handle sound broadcasting, television will have to be carried from station to station either by coaxial cable or radio relay links. A national network is planned, to be built within the next five years, using a combination of both methods Economic and technical details of proposals to use airplanes flying at high altitudes as television sources, covering wide segments of the country, must yet be tested. For the time being, television will be confined to the big cities, chiefly those on the east coast.

A typical station operating 28 hours a week will probably offer 12 hours of "mobile" shows (news, special events, sports, etc.), 10 hours of "live" entertainment (plays, short spots, skits, song-and-dance acts, news comment with maps, and similar stunts) and six hours of movies. Unfortunately, the movies, which offer the best possibilities for elegance, are likely to be old stuff unless the big movie companies, forever fearful of the effects of television on their big-money industry, bury the hatchet with television and furnish new films.

By fall, broadcasters will be able to use one of the most important inventions in electronic science: the new Image Orthicon camera tube (see accompanying drawings) developed by Drs. Albert Rose, Paul K. Weimer, and Harold B. Law, of RCA. It is 100 times more sensitive to light than prewar pick-up tubes.

Three of the five cameras that will cover the Louis-Conn fight this month will use the Image Orthicon. Two cameras will be mounted on a special platform, two in the NBC television box on the stadium's mezzanine, between first base and home plate, and the fifth beside the ring. Signals will be carried by wire to an ultra-high-frequency radio relay link, beamed from there to a receiving antenna on the RCA Building, fed through NBC's master control board for television, and finally carried by coaxial cable to the Empire State Building for transmission.

Bright lights produce intense heat, and it is no joke to be working near them on a cramped television stage. Such lights will not be needed when the Image Orthicon is in mass production, but until then studios will have to rely on several wrinkles to keep their actors cool. Sheets of special glass will absorb 87 percent of the heat and pass 93 percent of the light. A mercury vapor lamp rated at three kilowatts is said to be as cool at four feet as an ordinary desk lamp. Studio brightness eventually will decrease from several hundred foot-lamberts to around 50. For mobile broadcast, the Image Orthicon does away with bulky equipment and vastly broadens television's scope. It will be able to take almost any kind of spot-news event, regardless of the kind of

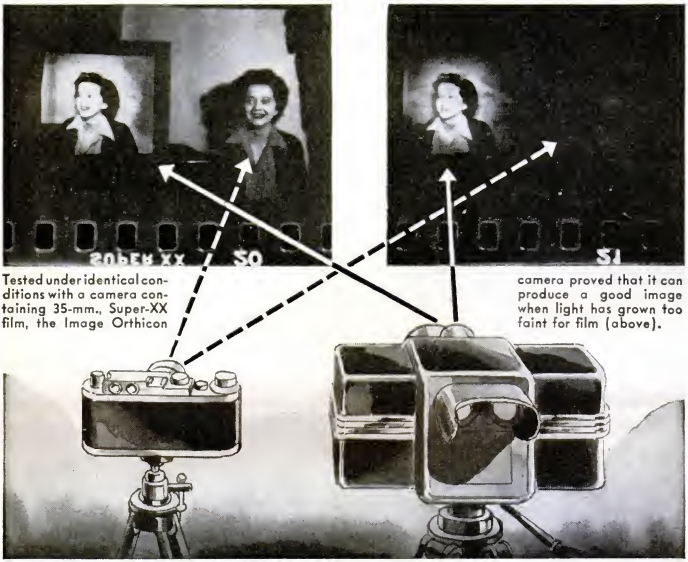
light in which it occurs. When turret lenses are also available for television cameras, quick switching from long shot to close-up will be possible; and breaks in the show, such as occurred at the U.N. broadcasts, will no longer be necessary.

No one knows how many sets will be in use by the end of the year, and no one can tell how many television stations will be operating. One big manufacturer who hoped to build 4,000,000 radios and 60,000 television sets has been forced to cut his estimates in half. It's anybody's guess if 50,000 or 200,000 television sets will be made this year, although everyone seems certain that in 1947 around a quarter of a million sight-and-sound receivers will be on the market.

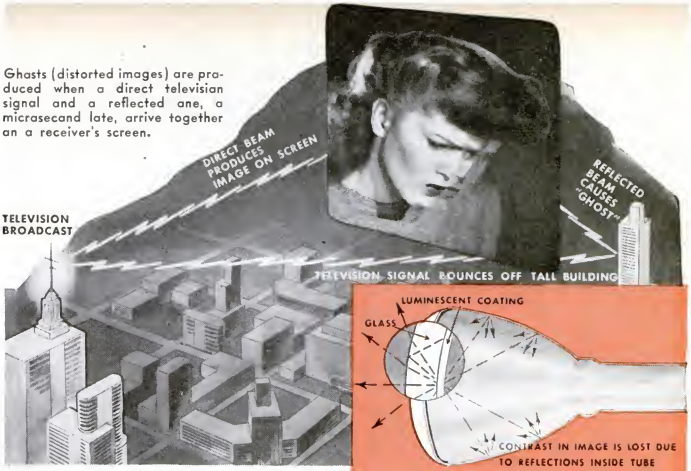
The black-and-white versus color controversy has clouded the broadcasting picture. NBC, backed by RCA, has locked horns with CBS over this issue. CBS, intensely proud of the accomplishments of its research engineer, Dr. Peter C. Goldmark, takes the position that all television should be standardized on the basis of its system. This would mean scrapping the black-and-white developments, moving television from its present band in the spectrum to a higher frequency, and re-engineering everything now ready for commercial use. If the industry would cooperate, says CBS, there is no reason why commercial color should not be a reality by next year.

NBC and RCA, as well as others who have lavished both time and money on television since it was merely a dream of the laboratory men, resent Columbia's insistence on the virtues of its system. They want a return on their investment and believe that the public should be allowed to see black-and-white shows *now*, no matter how bright the promises are for color next year. They argue that color television still needs years of basic research before it becomes commercially practical.

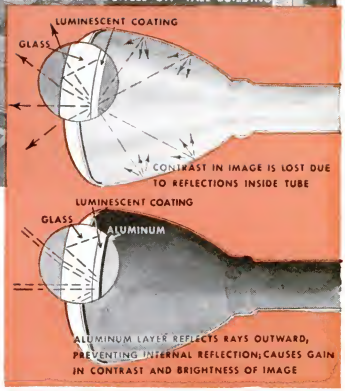
All wrapped up in the color fight are the intense personalities and the misty economics of the radio industry. In the opinion of the best minds in radio, the injection of the color issue at this time is certain to have




Tested under identical conditions with a camera containing 35-mm., Super-XX film, the Image Orthicon camera proved that it can produce a good image when light has grown too faint for film (above).




Ghosts (distorted images) are produced when a direct television signal and a reflected one, a microsecond late, arrive together on a receiver's screen.

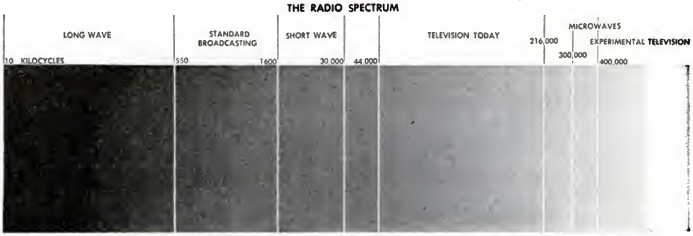



The aluminum-backed cathode-ray tube (right), three times as bright as prewar tubes, evolved from wartime experiments to preserve snow crystals.

a deterrent effect on the development of black-and-white. Already some 30 applicants for licenses to operate television stations have withdrawn their petitions from FCC. This would indicate that some of the men who want to invest from $400,000 to $1,000,000 in television would rather wait and see what happens.

But more important than the immediate controversy is the ultimate decision on where television should be placed in the radio spectrum. CBS, working on its color experiments in the region of 480 megacycles, believes that all television should be in that band. Others believe that an eventual move into that region or higher is inevitable—because there is more room there for individual broadcasters. The higher the frequency, the broader the transmission band can be; in the present television band from 44 to 216 megacycles the air is already so crowded that only six-megacycle channels are available. In the higher reaches, a 16-megacycle channel can be used. The width of the channel is extremely important; if standards are ever to be raised, in the direction of more picture frames per second and more lines of scansion, the channels will

THE RADIO SPECTRUM



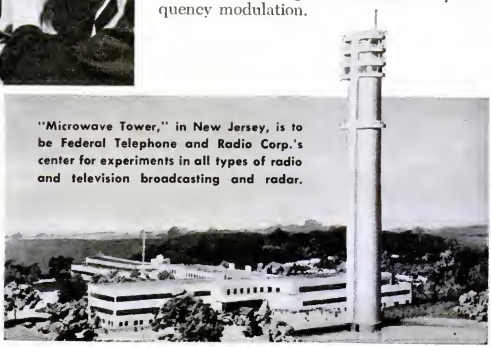
Rototing a 10-inch cathode-ray tube in her hands, the girl at right is distributing phosphorescent powder over the inner face of the tube, lined with liquid adhesive.

Spot welding the "gun" parts of a cathode-ray tube at a Dobbs Ferry, N. Y., plant. In the completed tube this assembly shoots electrons at the phosphorescent screen, causing it to fluoresce.

have to be wider. Obviously a faster transmission rate and a picture scanned with more lines produce more "information" in the television image, and bring to the viewer a picture of greater detail and exactness. It is quite likely that even before color is officially sanctioned for commercial operation, television will move up into the UHF (ultra-high-frequency) region or higher.

This summer FCC will hold hearings on a CBS petition to license color television commercially. Television is bound to move up some day. Today's band, where you can see National's WNBT at 66-72 on your dial; Columbia's WCBW (for black-and-white) at 54 to 60, and DuMont's WABD at 76 to 82, is simply a halfway house for the art. But it is a halfway house that promises a good period of occupancy. Regardless of the speeches and the fighting, commercial operation *has* begun. It will not be obsoleted any more than standard-band broadcasting was obsoleted by frequency modulation.

Image-correcting lens (left) and reflecting glass mirror provide larger, clearer television images.



"Microwave Tower," in New Jersey, is to be Federal Telephone and Radio Corp.'s center for experiments in all types of radio and television broadcasting and radar.

## Bull's-eyes in the Night.

Despite darkness (left), Yanks on Okinawa could see (below) and cut down unsuspecting Japs with the aid of the sniperscope. Attached to a carbine (left, below), the sniperscope emits infra-red light that shines on the target, is reflected, then picked up by the telescope mounted on the gun. The naked eye can't see the rays.

## New Ship "Props."

The six-bladed cycloidal propeller (left), now undergoing tests, may boost the speed of U. S. Navy ships three times as well as enable them to move sideways. A manganese-bronze rotor, powered by a spiral bevel-gear drive, spins the blades in a seven-foot orbit. Steering is done from the bridge by regulating the thrust of the blades, and the rudder is eliminated altogether. Prof. F. K. Kirsten, of the University of Washington, is the inventor.

# first with the fastest

**Obsessed with speed, Designer Kartveli builds tail winds into planes to assault sonic barrier.**

By LEON SHLOSS

IN THE movies the football coach figures out the play that wins the big game, the girl and the job, with a stubby black pencil on a restaurant tablecloth. In real life, Alexander Kartveli figured out an airplane design on the back of an envelope. That plane helped mightily to win World War II. And now Kartveli is designing another plane. This one may fly man past the sonic barrier.

Kartveli has been vice-president and engineering chief of Republic Aviation since its formation in 1939. He is a quiet, tanned genius who still speaks with a Russian accent after 20 years in the U. S. If he is the first to turn out a plane with speed surpassing the velocity of sound, the attainment will fit properly into his long record of designing very fast aircraft. The envelope doodling took place in August 1940. Nine months later the hieroglyphics flew as the now famous P-47 Thunderbolt.

The strafing, bombing T-Bolt was the first 400-mile-an-hour American fighter. Before it, Kartveli had designed the P-43 Lancer, first 300-mile-an-hour fighter. After P-47 he built more speed into the Thunderbolt until, as P-47J, it became the first 500-mile-an-hour fighter. Recently he turned out the first 600-mile-an-hour fighter, the P-84 Thunderjet. Just before that, his Republic Rainbow, first 400-mile-an-hour commercial transport, made its successful bow. Kartveli is now working on a new transport, which Republic thinks will be the first in the 500-mile-an-hour class.

"Give Kartveli and another designer the same power to work with," say many men in the aviation industry, "and Kartveli will build a plane 50 miles an hour faster than the other fellow." He is the first, however, to state that there is no magic involved. Just hard work and assiduous employment of available data, the mountain of information that has accrued from minute and tedious laboratory studies and tests—plus, according to his votaries, "Kartveli's ability to make the equations fly."

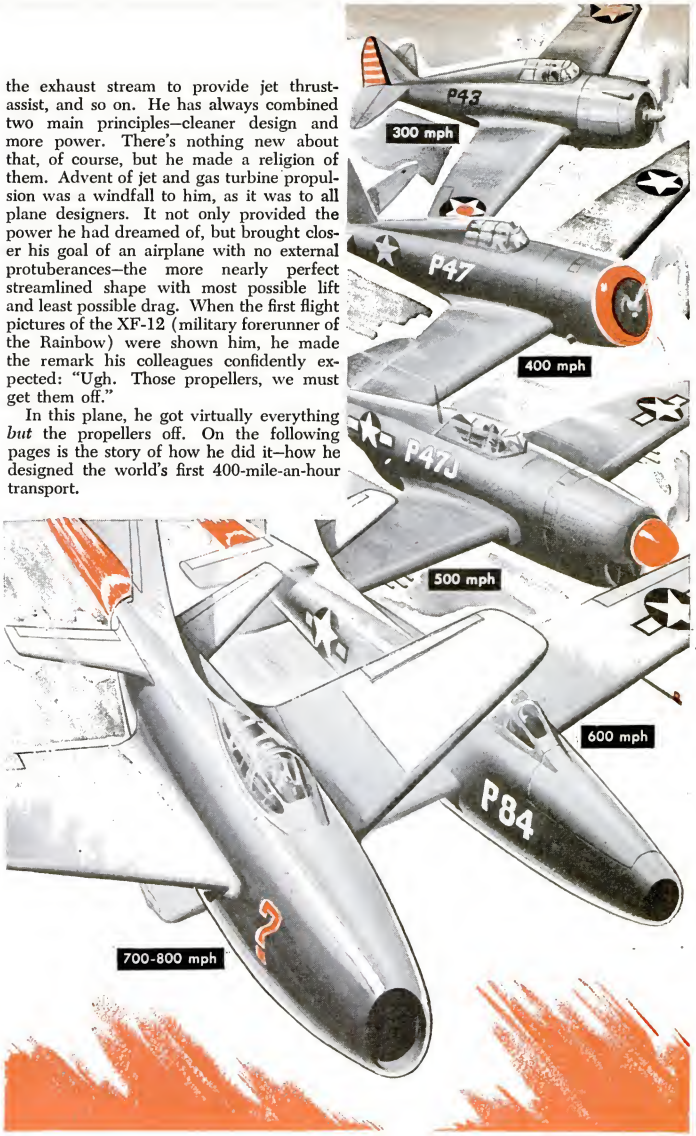
"Commercial flying," says the designer who hasn't piloted a plane in 20 years, "will cease to be thrilling in a few years. Passengers on a long flight will be as bored as though they were on railroad trains. There will be only one justification for flying . . . speed. So, let us fly fast, or walk."

That conviction governs Kartveli's work. In the Rainbow he wanted a long-range, high-speed passenger transport. Many of the steps he took to wheedle his beloved speed caused staggering engineering problems, which had to be solved before production methods could be evolved. He and his engineers solved them. The end product is a 46-passenger air liner that will fly from coast to coast in six hours.

Kartveli achieved this engineering masterpiece by picking up a few miles an hour here and there, some by designing a revolutionary engine nacelle, a few by adding tail-plane dihedral, a little bit with unique cowl flaps, quite a few more miles by using

the exhaust stream to provide jet thrust-assist, and so on. He has always combined two main principles—cleaner design and more power. There's nothing new about that, of course, but he made a religion of them. Advent of jet and gas turbine propulsion was a windfall to him, as it was to all plane designers. It not only provided the power he had dreamed of, but brought closer his goal of an airplane with no external protuberances—the more nearly perfect streamlined shape with most possible lift and least possible drag. When the first flight pictures of the XF-12 (military forerunner of the Rainbow) were shown him, he made the remark his colleagues confidently expected: "Ugh. Those propellers, we must get them off."

In this plane, he got virtually everything *but* the propellers off. On the following pages is the story of how he did it—how he designed the world's first 400-mile-an-hour transport.



**POWER:** The Pratt & Whitney Wasp Major engine, which develops well over 3,000 horsepower, was available. Four of these massive motive plants were used. In addition, the exhaust gases, which normally increase drag as they escape uncontrolled from the engine to create turbulence, were diverted through nozzles placed at the after end of the nacelles, to provide extra thrust. Further, the air that cools the engine is discharged outside at high velocity around the forward section of the nacelle and adds still more thrust.

**WING:** Mid-wing was desired to preserve uninterrupted, smooth flow of air over the wing. On the conventional low-wing transport, speed-killing turbulence occurs as the air flows off the trailing wing edge at the fuselage. Placing fillets there to lead the air off smoothly only partially reduces the turbulence. On a mid-wing plane the side of the fuselage itself leads the air smoothly back and off the structure. High- or low-wing airplanes are attractive, production-wise, because wing stressing can be built straight through, from wing tip to wing tip. To get his mid-wing, Kartveli had to design a doughnut-shaped wing spar to go around the passenger cabin and strong enough to keep the wings on the airplane.

**FUSELAGE:** Here has been the parasite of the airplane. It contributes no lift but adds great drag. At high speeds this drag is chiefly skin friction—air sticking to the metal skin. Kartveli's objective was to streamline the fuselage as perfectly as possible. He was successful to the extent that the fuselage drag of the Rainbow is only half that of a conventional four-engine airplane with the same wing (lifting) area. Outstanding was the trick he played on the:

**NOSE:** Transport airplanes traditionally have had the pilots' cabin set back on top of the nose for visibility. The turbulence created as the onrushing air starts over the nose and suddenly is bumped upward by the set-back windshield is a speed-robber. So the Rainbow's nose was entirely streamlined by Kartveli—and a set-back windshield of inch-thick glass placed inside. For take-offs, landings and other situations where high visibility factor is essential and

speed is not, the top half of the streamlined nose splits and retracts, leaving the conventional set-back windshield.

**COWL FLAPS:** Conventional cowl flaps open outward and upward and help ruin streamlining. Rainbow cowl flaps slide forward and backward on a perfect line with the engine nacelle's outer surface. In the forward position a recessed opening is uncovered. Air is taken in through fans in the nose of the engine installation, cools the engine, and is released through this opening.

**TAIL:** Sharp dihedral was given the planes of the tail assembly. By thus slanting these "wings" of the empennage upward from root to tip, the air rushing over the real wings of the plane sweeps smoothly below the tail. Thus additional turbulence, often created in other planes as air sweeping off the wings bumps into the tail assembly, was precluded.

**ENGINE NACELLES:** Here, possibly, Kartveli performed his greatest sleight of hand. A slim, streamlined nacelle was desired because nacelle drag in a four-engine plane runs to 20 percent of total drag of the plane. First, a long slender nacelle, running from well forward of the leading edge of the wing to well behind the trailing edge, was designed. This disposed of another speed-stealer, the turbulence that occurs in the conventional engine installation, which is set in the leading edge and breaks off sharply into the wing surface a short distance back along the wing. In the Rainbow, air flows smoothly all the way back along the nacelle, thus contributing to the lift of the wing.

But—and there were two big buts. To preserve slimness, the landing gear, which normally folds up into the nacelle, had to be put somewhere else. The only other place available was the wing, and to put a fat, double-wheel landing gear into the thin-for-speed wing was impossible. So Kartveli and his engineers designed a single-wheel gear which would stand up under the same impacts—and more—as the double-wheel gear. There were engineering difficulties aplenty. But the hurdles were successfully topped.

Next was the job of getting rid of the various air intakes, which perch astride con-

ventional nacelles. Air had to be had to cool the huge, radial engines and to provide the hot gases for jet thrust-assist. Kartveli thought it might be inducted through slots in the leading wing edge. So he had several small-scale wing sections built, with leading-edge open lips of varying degrees of sharpness. The very sharp lip was good for speed but bad for lift. The very blunt lip was good for lift but bad for speed. A satisfactory compromise was found. The air comes in through the leading edge of the wing. The air scoops are gone. Speed has been added.

The streamlined nacelle was attained. With it came a speed bonus. Its cigar shape led the air flow over the outer surface clear back to the nozzle, through which the hot exhaust gases were expelled to add propulsive thrust. And these gases sucked more air, faster, off the nacelle skin, thus reducing the thickness of the boundary layer of air that clings to an airform and reduces speed.

The Rainbow will cruise at 400 miles an hour, with a top speed of 450 m.p.h. Kartveli's next new transport will cruise at 500, with a top speed of 550. He is sure of two things he is going to do to add this 100 miles an hour: first, the plane will be powered entirely by jet or gas-turbine propulsion; second, the wing will be thinner. All data leads to the conclusion that the thinner the wing can be made, and remain structurally safe, the faster an airplane will be. The engineer's "bible"—available data—tells Kartveli also that a swept-back, or boomerang-shaped wing, may lend itself to additional speed.

Out of these three facts emerges the general outline of the 700 m.p.h.-plus fighter that may be the first to transport man faster than his voice travels. It probably will be a jet-propelled machine with thin, swept-back wing. The Thunderjet fighter, flying at better than 600 miles an hour, has a so-called 12-percent wing. That means that the depth of the leading edge of the wing is 12 percent of the distance from leading edge to trailing edge. Kartveli believes this relationship can be brought down to 10, even 8 percent. However, as aircraft speeds grow greater, vibration threatens to tear a plane apart. Kartveli thinks the first step toward solution is to reduce the size of the aircraft. So the sonic plane probably will have stubby as well as thin wings and a short fuselage.

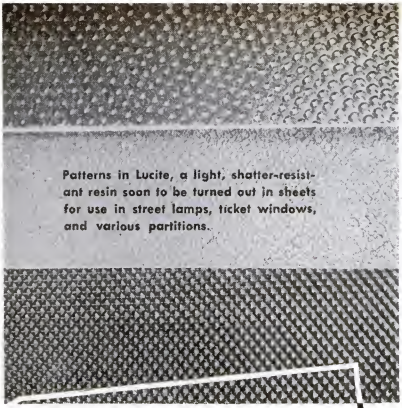
Kartveli points out that aircraft engineers were reaching their limits when the new jet-power vista opened. Efficacy of thin, swept-back wings and stubby shapes was known, but all of these, driven by maximum power output of conventional engines, could not knife through the almost tangible wall of air that builds up at velocity of sound. Now, he believes, piloted flight at sonic speeds is not distant. He says the present is the critical design period because of the compressibility problems presenting themselves as speed of sound is approached. He believes that once speed of sound is passed, design problems will ease because supersonic air flow probably is steadier. An interesting facet of Kartveli's current activity is his use of ballistics as well as aerodynamics data in seeking the perfect streamlined shape.

The Army Air Forces gave Kartveli a million dollars to work with on the strength of the envelope design, and ten million more to work on the XF-12. They have ordered 100 Thunderjets and are talking about more XF-12s. Pan-American World Airways has bought 18 Rainbows; American Airlines, 20.

Kartveli got into aviation in 1919 in Paris, where he had gone to continue his military studies. An artillery officer in the Russian army in World War I, he felt he should know about any machine that gave promise as a weapon. He espoused the all-metal plane, at the time scoffed at by fabric-plane builders. Too costly, too heavy, too much vibration, they said.

Since then, Kartveli has done quite a job of confounding his critics—and his planes are flying VERY fast.

On his office wall hangs a drawing of a turtle. Beneath it: "Witness the turtle. He maketh no progress unless his neck is out."



Patterns in Lucite, a light, shatter-resistant resin soon to be turned out in sheets for use in street lamps, ticket windows, and various partitions.

# Plastic Products Coming Your Way

DuPont's CCA (cellular cellulose acetate) is so light a girl can hold a bundle of it with one hand. Yet a coating of CCA makes a suitcase strong enough to bear her full weight. Insert shows a close-up of the same core material with an aluminum facing.

A brief case of nylon sheeting, not yet in commercial production, has been embossed to look like leather. It is exceptionally tough though flexible, and is hard to scratch.

On a hot plate at 390 degrees F., Teflon (below, at right), a new resin used in gaskets and wire insulation, retains form and strength while rods of two other plastics have melted or swelled out of shape.

## Tiny Machine Turns Pages

A mechanical page turner devised for crippled veterans by R. F. Mallina, of Bell Telephone Laboratories, can be controlled by foot, knees, or even chin. A round paper clip is fastened to each page of a book on a reading board, and cotton thread, strung through the clips, is attached to a motor-driven roller at the side. A microswitch, operating like a push button, starts and stops the tiny motor.

## Firemen of London Learn Nazi Stunts

Ways and means the Germans used to fight fires and clear away debris during their blitz are being studied from appropriated equipment by London's firemen. At left is an emergency tender, manufactured by Metz, on a Mercedes Benz chassis. Its novel feature is a crane with a lifting capacity of 4½ tons and a jib that folds onto the roof. The tender has an electric generator, for operating saws. Photo shows the crane lifting a damaged automobile after a street crash.

**Quick Aid to Injured Miners.** Mounted on rails and electrically heated, the ambulance below, in use at Piney Fork Mine, Ohio, can quickly move underground in case of an accident. It carries first-aid supplies and a cot that can be rolled into a regular ambulance at the mine mouth.

Fire of gasoline-soaked rags is put out (right) in less than three seconds as vaporized methyl bromide from the tiny extinguisher smothers the flames with a blanket of heavy, noncombustible gas.

**Extinguisher, shown with its bracket, is small and light because it takes only 40 lbs. pressure per square inch to keep methyl bromide liquid at normal temperature; it may take 1,000 for carbon dioxide.**

# *HANDY Fire Department*

HARDLY a handful, a new fire extinguisher quenches blazes as quickly and thoroughly as extinguishers much larger and heavier. It contains liquid methyl bromide, a solvent that replaced carbon dioxide in the automatic fire-fighting systems of RAF fighters and bombers.

One turn of a simple valve releases a six-foot stream of methyl bromide, forced out by its own pressure, which vaporizes instantly and chokes the flame with a gas heavier than carbon dioxide or carbon tetrachloride vapor. The gas is equally effective in putting out rubbish, oil, gasoline, and electrical fires, and does not wet things, stain textiles, or ruin paint. The cylinder is refillable.

The midget extinguisher can also be used to help start cars or boats stalled by dampness. When sprayed on ignition wires, plugs, coil and distributor, it removes conducting dirt and impregnates the insulation with noninflammable, nonconducting methyl bromide—replacing the water.

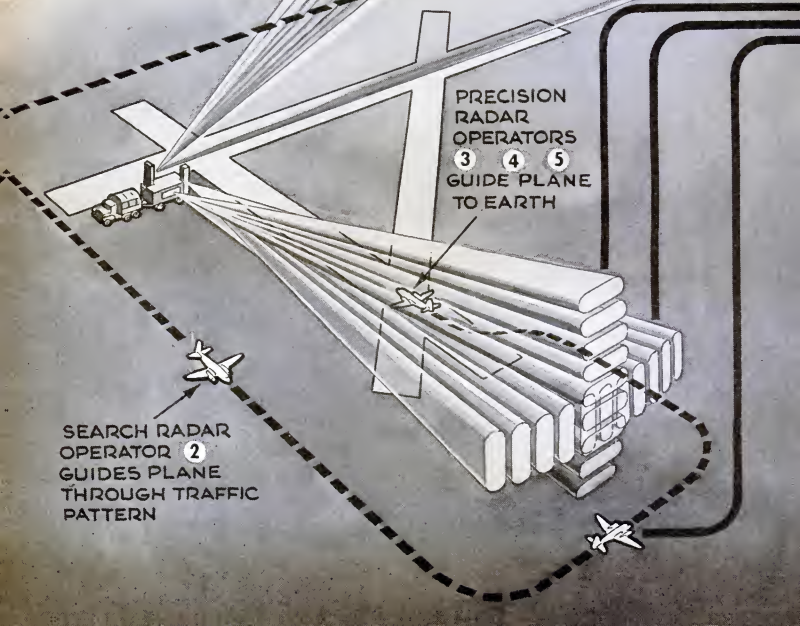
Though methyl bromide is toxic, it is no more so than carbon tetrachloride vapor, used for the same purpose, and therefore requires the same precautions.

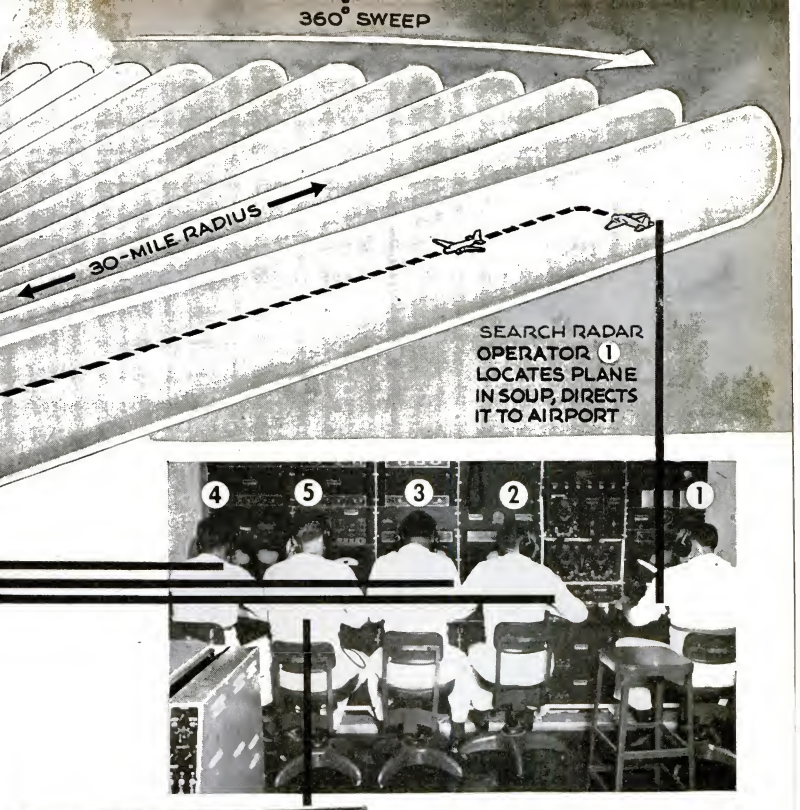
# RADAR *becomes* LIFE LINE

## Navy landing system pulls planes out of the soup.

PILOTS without radar experience, or a lot of special equipment, can land safely in the thickest fog when guided by the Navy's mobile GCA (Ground Controlled Approach) system. To use this war-born technique for radar landings, a pilot needs only a two-way radio, basic knowledge of instrument flying—and confidence. Confidence is instilled by the search-radar operator, who finds the lost plane on his 'scope, and tells the pilot exactly where he is, where the field lies, and what heading he is flying. From then on, the pilot is continually being told his position in relation to the field and how far away it is. The length, width, and magnetic heading of the runway, and the speed and bearing of the surface winds are relayed to him, so that he will have all information needed for a safe landing.

Fogbound air-line pilots, with no previous knowledge of GCA, have landed with its aid. The Navy plans to teach this method to all its fliers.





Operator 1 spots plane on a 'scope and radios the altitude and bearing that the pilot must fly to enter the field's traffic pattern. No. 2 guides the incoming plane through the traffic pattern. No. 3 notes its position relative to the runway; No. 4 watches its descent. Operator 5, guided by the findings of Nos. 3 and 4, tells the pilot how to land safely.

Operators 3 and 4 track the incoming plane with a "cursor," which overlays the face of the 'scope. This information is transmitted to the instrument at left, where it is indicated in feet on the dials. Operator 5 reads these dials and tells the pilot how many feet left or right of the runway he is, how far above or below the glide path, and his distance in miles from the end of the runway. Guided to the end of the strip a few feet above the ground, the pilot then lands visually.

# The HOUSE that has EVERYTHING

**$250,000 California sample shows what science can do to homes.**

A $250,000 HOUSE with every available postwar convenience, and some not yet for sale, has been built by a Los Angeles contractor to show how much scientific luxury a home can offer. Fritz B. Burns, who with Henry J. Kaiser plans to produce 10,000 moderately priced prefabricated houses for crowded Californians by next June, knows that his palace of improvements is way out of the average house hunter's reach. But purchasers will demand some of these con-

The house that Burns built has this outdoor barbecue corner, equipped with an electrically operated charcoal broiler, spit, grill, and oven, a gas refrigerator, and other conveniences.

The comfortable wide-roofed porches are illuminated at night by 150-watt incandescent lamps flush-mounted in the ceilings.

veniences in low-cost homes, he believes, and Burns and Kaiser intend to provide them.

Under its aluminum-shingled roof, Burns's house has only two bedrooms, two baths, living and dining rooms, garage, and extra space for hobbies or old trunks. But its sewing machine disappears, there are electric toothbrushes in the bathrooms, and ultraviolet rays keep the medicine chests sterile.

Picture windows and decorated walls beautify the living room. In the kitchen, where circular shelves rotate to save steps, there is a "nerve center"—a control board from which the housewife can manipulate the lawn and garden sprinklers, raise the garage door, and turn on her radio. From here, she can talk to every room in the house. In a cabinet in the master bedroom, infrared lamps dry her stockings in a jiffy.

The kitchen's hydraulic dish washer lifts a basket to receive dirty plates and lowers them into churning soapy water. The filtering unit in the sink traps grease, while the garbage-disposal unit even chews up bones. The clothesline raises and lowers itself at the touch of a button.

Radio entertainment is available in every room. There are two high-fidelity receivers behind sliding panels at the left of the fireplace. And the house contains recording equipment, an automatic record player, and a built-in television receiver.

Oversize bed in the master bedroom has fold-down arms to make night reading easy. The wall coverings are of stain-proof material.

The kitchen has the new Western rear-burner gas range, the Kaiser hydraulic dish washer, a refrigerator, and garbage-disposal unit.

An electric sewing machine pops out of a kitchen cabinet when needed. The seamstress controls the rate of stitching by operating a lever with one knee.

Revolving Plexiglas door (at right, above) converts bathtub into a shower. Mirror magnifies for shaving, makeup.

Mother sits down to iron in an all-electric laundry. Equipment includes a washer, rinser, and drier. The ironer disappears under a counter when not in use.

House front, with its informal planting, is brilliantly lighted. Arizona flagstone, wallstone and plywood form the walls.

Tiny bulbs glowing under plastic push-button plates show guests where to turn off lights. Because this system carries low-voltage electricity it uses open bell wire from switches to fixtures instead of conduit or heavy wire. And there is never a burned-out fuse to change; a main circuit breaker in the garage takes care of that. It feeds current to a pair of circuit-breaker panels elsewhere in the house, and if a short circuit causes a momentary overload, these circuit breakers automatically close a small switch. To restore the current, someone merely flicks the switch open.

There are no drafts or cold floors in the Burns house; "Moduflow," an automatic temperature-control system, balances heat input and loss. And dust is unknown. An electronic system called the Precipitron clears the air of all dirt and foreign particles. Air passing through the Precipitron flows over many strands of fine tungsten wire, thinner than human hair. These wires, carrying electricity, charge dust negatively. Positively charged plates then pull dust out of the air.

# Our World Ages Violently

**And when its face slips, as in April, there is a rumpus.**

By DONALD H. MENZEL
*Professor of Astrophysics, Harvard University*

FROM a center not far from Dutch Harbor in the Aleutian Islands, a circular wall of water sped over the surface of the ocean on April 1 at an estimated speed of 400 miles an hour. Near the point of its origin, the wave may have been well over 100 feet high. The waves that hammered the west coast of America from Alaska to Chile were 10 feet high in certain regions. Those that devastated Hilo and other Hawaiian beaches, causing millions of dollars in property damage, ranged from four to six feet in height. The effects were noticeable even at Midway and Wake Islands.

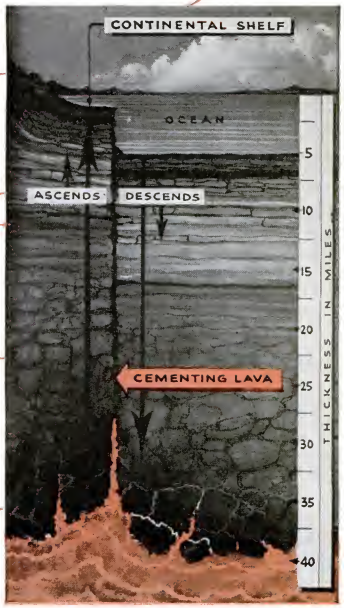
What forces of nature caused this great disturbance? The term "tidal wave," commonly applied to any tide of unusual height, does not accurately describe it. Gravitational pull of the moon upon the oceans causes the ordinary tides (two high and two low tides per day). The sun also exerts a tidal pull; and the ebb and flow of these tides caused by the sun and moon can be predicted many years in advance. Variations in the predicted sea level, however, are due to other outside forces, none of which is truly "tidal."

The most destructive and far-reaching pseudo tidal waves are those produced by submarine earthquakes, the result of a shifting of the earth's ages-old surface.

The rocky crust of the earth extends to a depth of about 40 miles, where the temperature reaches 1,300 degrees Centigrade (2,400° F.). Here the rocks melt, and the entire exterior would float except for the heavy pressure exerted by the overlying rock masses. This 40-mile-thick crust is broken

HAWAII

The earth's crust resembles a jigsaw puzzle of interlocking pieces, as pictured below, glued together by molten rock of the interior. The deepest cracks lie around the borders of the Pacific (above) where sharp drops in the ocean floor indicate that vast blocks have slipped, creating great depths. When red-hot lava does reach the surface, volcanic action results.



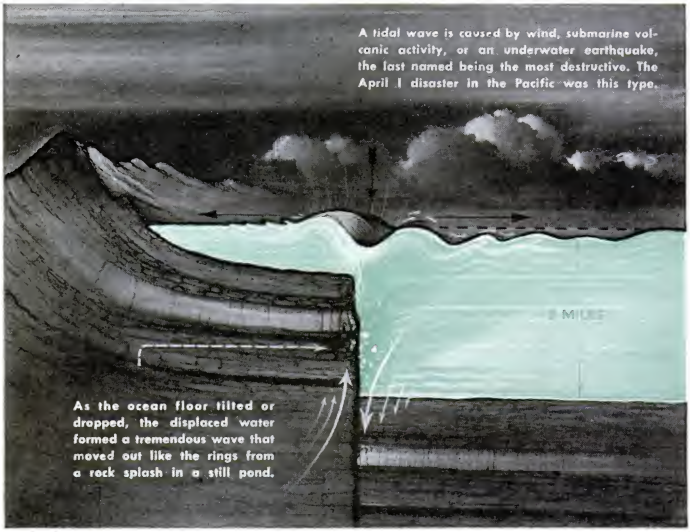
and cracked. There are millions of crevices and fissures, some only a few miles deep and others that extend all the way to the semi-liquid interior. The molten rock tries to force its way up between the fissures, but ordinarily it solidifies along the cracks, forming a fairly effective glue.

Not all the pieces, however, are in their most stable position. Erosion of land from one mass and accumulation of silt on an adjacent piece will make the former lighter and the latter heavier. The changing weight of ice and snow exerts additional forces. Thus, there is a tendency for the eroded continents to rise and for the heavier submarine areas to sink.

Geologists refer to movement of one section against its neighbor as "faulting." If one end of a block has slipped and jammed, the next movement is most likely to appear —possibly years later—at the opposite end. Sometimes the faulting occurs at deep levels. At other times the slippage may be quite apparent at the surface. Earthquakes accompany each movement, registering themselves on distant shock-recording machines known as seismographs. Hundreds of minor quakes occur every day, and analyses of the recordings enable seismologists to study the structure of the earth's interior.

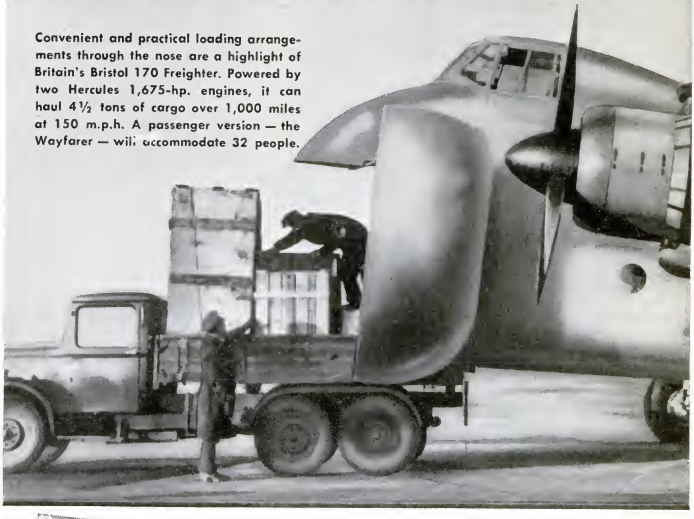
It is difficult to find any consoling thought in the recent Pacific Ocean disaster, but if the catastrophe were unavoidable, we may be grateful that it occurred now and not immediately subsequent to the atomic-bomb tests in Bikini Atoll. Had these oceanic disturbances followed hard on the heels of the dropping of the atomic bomb, scientists would have faced a problem in combatting the widespread notion that the Bikini explosion had upset the equilibrium of mother earth.

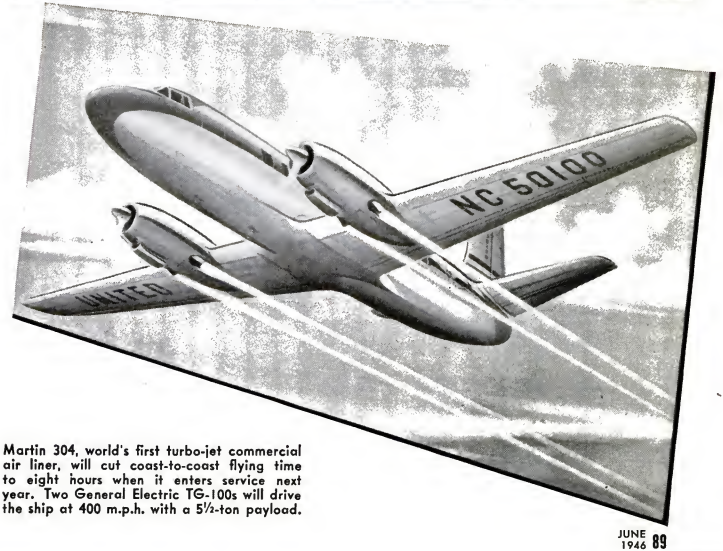
Great as the energy of a bomb may be, it cannot carry enough force to displace appreciably a solid crustal block weighing many quadrillion tons. It is altogether likely that the tidal strains and stresses within the earth eventually trigger the earthquakes that accompany the settling of some blocks and the rising of others. From a purely scientific standpoint, quakes and tidal waves are mere incidents in the gradual aging and evolution of an insignificant planet —our earth.



# WHAT'S NEW in AVIATION

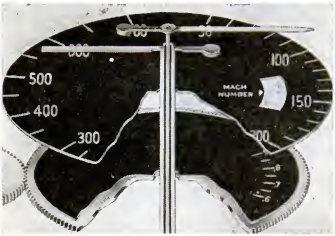
Convenient and practical loading arrangements through the nose are a highlight of Britain's Bristol 170 Freighter. Powered by two Hercules 1,675-hp. engines, it can haul 4½ tons of cargo over 1,000 miles at 150 m.p.h. A passenger version — the Wayfarer — will accommodate 32 people.





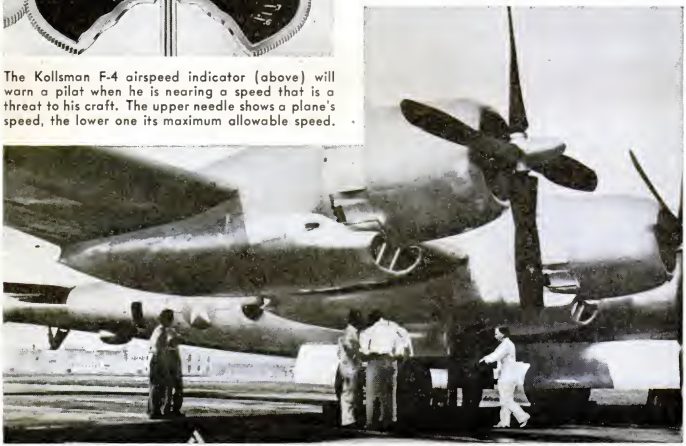

Martin 304, world's first turbo-jet commercial air liner, will cut coast-to-coast flying time to eight hours when it enters service next year. Two General Electric TG-100s will drive the ship at 400 m.p.h. with a 5½-ton payload.

Nestling snugly against the sleek underside of the Constellation (right) is the new streamlined, all-metal container that holds four tons of express, mail and baggage. Developed by Lockheed and named the Speedpak (inset, below), the external carrier can be attached to the fuselage belly in two minutes, or removed in the same brief time. Its use will greatly reduce ground-waiting time along Constellation air-line routes. The sky giant, with loaded Speedpak attached, can be used for flights up to 1,500 miles, its cruising speed cut only 10 m.p.h.




The Kollsman F-4 airspeed indicator (above) will warn a pilot when he is nearing a speed that is a threat to his craft. The upper needle shows a plane's speed, the lower one its maximum allowable speed.

Increased power and improved flight performance are gained with the new-type nacelle (close-up below) designed for the XB-44, a forerunner of the new Boeing B-50 Superfortress. In addition, a crew of six men can change the engine units in a half hour. It takes six men eight hours to do the same job on the wartime B-29. The B-50 will be powered by four 3,500-hp. Pratt & Whitney engines and equipped with four-bladed, reversible-pitch Curtiss Electric propellers. A marked improvement in take-off, rate of climb, and speed has been revealed in current tests.



The two-place Northrop F-15 Reporter is designed to do a photo-reconnaissance job only converted bombers formerly could do. Carrying six cameras in the nose, with 24 optional set-ups, it can "shoot" from seven miles up, has a range of 4,000 miles and a speed in excess of 440 m.p.h.

**Diminutive Dynamo.** Only one-fourth the size of a match's head and set in half of a small pearl, this dynamo speeds at 6,000 rotations a minute and generates electricity that can actually be measured by an electrometer. Made by M. Fernand Huguenin, Swiss watchmaker, the machine has 46 stainless steel parts, some of which can only be seen with a microscope, and weighs .06 gram.

**Farm Tool Lays Sidewalk.** No sand or gravel is needed for laying sidewalks, roads or airfield runways when the versatile Rototiller, primarily a cultivator, is used for making soil cement by mixing dry cement and dirt. Revolving steel tines under the machine mix earth and cement uniformly to a depth of from one to 12 inches, as desired. The mixture then needs only to be sprinkled and rolled.

**Flame Thrower Works in Woods.** Its war work done, the flame thrower has been converted into a device for setting fire to piles of brush and debris, called slash, during the rainy season in the Northwest. The kerosene-filled tank will fire hundreds of slash piles a day, thus eliminating a serious potential fire hazard.

# $100,000,000 harvest . . . from ideas

## Research founded Monsanto Chemical Co., keeps products pouring from its labs.

By J. D. RATCLIFF

THE new products promised for the postwar world are beginning to pour from laboratories—homely little things that will touch our everyday lives. Things like:

An invisible coating for fabrics, which will prevent ladies' slips from slipping; and make stockings virtually runproof.

Insulating material so efficient that your new refrigerator, though no bigger than your old one, will hold 40 percent more food.

A baking powder that doesn't produce bubbles until the dough is in the oven—thereby making lighter biscuits than Grandma ever dreamed of.

A chemical treatment for overalls, sportswear or children's clothing that triples the life of the garments without altering their appearance.

A soap that makes no suds at all, yet is much more efficient than any soap you've ever used.

All these things are here now, and they all come from the laboratories of the Monsanto Chemical Company. No organization better exemplifies the value of research. It is the lifeblood of Monsanto, its only life insurance in a changing world. As a matter of fact, the company was born in a laboratory—of a research accident.

A chemist at Johns Hopkins complained to his wife that the ham sandwiches she made for his lunch had a sweetish flavor. Had she added sugar? She said she hadn't. Next day's sandwiches were just as sweet, so the chemist started investigating. He had

A wool sweater treated with Monsanto's plastic Resloom shrinks only a very slight amount in washing and is exceptionally hard to wrinkle.

The same-sized sweater, untreated, shrinks a third after having been washed in hot water (below). Resloom's protection can be extended to cotton, rayon, and other fabrics.

The untorn leg of Junior's overalls (below) was coated with Monsanto's hard plastic Merlon, a styrene-based compound that doubles or triples the wearing life of fabrics.

The cloth at left above blackens but refuses to burn because it has been saturated with a new chemical, being developed at Monsanto's Central Research Laboratories, Dayton, Ohio. The chemical may make possible the fireproofing of cottons, rayons, and other fabrics at the mill.

been studying coal-tar derivatives, and tiny amounts of his experimental material had clung to his fingers and given his food a sugary taste. Thus he discovered saccharine.

In 1902 the late John F. Queeny, St. Louis drug salesman, took $1,500 of his savings, borrowed $3,500, and started making saccharine. He named his company Monsanto—his wife's maiden name. The German chemical trust tried to drive him out of business by cutting the price of saccharine from $6 a pound to 60 cents. Queeny hung on by his teeth, all the time conducting research for new products that would strengthen his position.

Eight-ounce raincoats can be made of Monsanto's Vinyl Butyral, which also produces lacy shower curtains, jam-proof tablecloths, and washable seat covers. Syton, another product, helps prevent stocking runs.

Monsanto's $3,000,000-a-year research program is spread through six laboratories. The most interesting of these is at Dayton, Ohio. Now known as Central Research, this laboratory was founded in 1926 by Drs. Charles A. Thomas and Carroll A. Hochwalt, members of the General Motors research team that earlier had discovered ethyl gasoline. In their mid-20s these men left General Motors laboratories to set up shop for themselves.

Monsanto bought out the two scientists in 1936, and retained them to work on products that might not hit the market for half a dozen or more years. When war came, Central Research worked on atom bombs, rocket propellants, and other secret projects.

Britain expected invasion, and feared Germany might capture the vast stores of gasoline in the coastal areas. To fire the gasoline, to keep it out of the hands of the Germans, would endanger the lives of thousands of people. Monsanto chemists devised a resin that could be added to gasoline without altering its smell or color. The British planned to add this resin when the Nazis

**Wool socks and blankets that have been Resloomed (at left in both photos above) can safely be put in the family wash while untreated ones of the same size shrink drastically.**

arrived. The Nazis would use the captured gasoline in their tanks and planes—as they had in France. Within minutes their engines would be hopelessly gummed up. Thus one of history's biggest booby traps was set—but never sprung.

Body armor—first since the Middle Ages—was another product that Monsanto cooperated in developing. Fifteen plies of glass cloth, glued together with plastic, made a light armor stronger than steel. Vests of this stuff weighed 30 pounds, would stop a tommy-gun slug. These vests were used on a small scale in the Okinawa landings and would have been general issue had the assault on Japan ever developed.

Throughout the war the company's 325 scientists concentrated on research directly related to military applications, including operation of the atomic-power research laboratory at Oak Ridge, Tenn. But scores of new ideas were dammed up.

Resloom is one of the most fascinating of the lot. Wool fiber contains microscopic caverns. Resloom is a clear plastic stuff used to fill these cavities. Once filled, the wool loses most of its ability to shrink. Wool flannel normally shrinks 30 percent, but when Resloomed it shrinks only four percent. Worsted suitings shrink three percent, not 11. In one series of tests, wool shirts were washed in the hot water ordinarily used for cottons. After five washings they had shrunk a scant 1½ percent. From now on sweaters, socks, underwear and other such woolen goods may be thrown in with the rest of the family wash. Incidentally, it will cost mills nothing to apply Resloom. By eliminating shrinkage normal in wool manufacture, it will more than pay for itself!

Syton is another Monsanto development This is a microscopic silica-sand dispersion. In effect it gives a sandpaper coating to fabrics that is permanent, will not wash out. The particles are so tiny that they can neither be seen nor felt. One of the most obvious applications for this is in women's slips. When it is used, women will no longer have to tug climbing, twisting undergarments back to where they belong.

It will also be used to make stockings virtually runproof. The sandpaper coating on fibers makes them cling together. On a snag machine—where a tiny hook is dragged over the precious stockings—one stocking developed 60 runners. Its treated mate developed only seven.

Another new chemical, a water repellent, finds applications in both men's and women's clothing. Rain runs off treated cloth as off a duck's back. In one practical test a man wore an untreated suit out in a rainstorm. The suit was soon a soggy mess. A treated suit remained dry and well pressed.

Most parents would judge Merlon to be Monsanto's most spectacular development. In effect, this is a hard plastic coating for fibers—a varnish so thin that it cannot be seen by the eye or felt by the hand. Yet it doubles and sometimes triples the life of cotton and other fabrics. General use of this cheap stuff will mean an enormous saving in hard-usage garments—children's cloth-

Lustron (left), a new plastic that glows for six or eight hours after it has been exposed to sunlight, will be used in markers.

Both pieces of duck canvas above were buried six months. Fresh-looking one at right had been treated with Monsanto's 8-Quinolinol, remarkably effective against mildew.

ing, overalls, work shirts, and hotel sheets.

A new insulating material looks like snow, pours like water. It is twice as efficient as the best insulating material now available. Too expensive for home insulation, it will find scores of space-saving specialty jobs: in refrigerators, in planes, frozen-food storage compartments, refrigerator cars.

Monsanto's sudsless "soap" is 40 percent more efficient in cleaning power than soaps now on the market. It was specifically designed for use in automatic home laundries.

The plastic that was used in wartime body armor fits perfectly into a mass production scheme. Picture sheets of cotton cloth, paper, glass fiber or other fabric flashing through a mill. Rollers coat both sides with plastic. A dozen or so of these coated sheets come together and are squeezed through a heated roller. Result—a board as rigid as plywood. This opens the way for large plastic sections previously impossible to make—wall panels, doors and such. The treated fabric may even be draped over forms and baked in an oven to make canoes, truck bodies and other intricate shapes.

Monsanto's chemists are playing a leading role in the war on pests—both agricultural and domestic. They are making a new rat-killer (discovered by the National Defense Research Committee) ominously labeled No. 1080. It is the answer to a mystery writer's dream. It is dozens of times more effective than any other rodenticide known because it is almost entirely without identifying color or odor. Recently, St. Louis planned a city-wide rat extermination drive. Calculations showed five pounds of No. 1080 would be enough to kill all rats in the municipality. The poison strikes so quickly that rats travel no more than five or six feet from the bait before tumbling over.

Monsanto employment has risen from 2,000 in 1929 to more than 12,000 today, its sales from $17,000,000 in 1929 to $100,000,000 in 1945. The things mentioned are but a fraction of Monsanto's total research output. In the past 12 months 70 new products have emerged from the laboratory—all of which will be translated into new industries, new jobs.

An impressive record? Certainly. But Monsanto's biggest adventure in research is just ahead. A few weeks ago the Manhattan Engineering District gave the company this assignment: *Design, build and operate the first atomic-energy plant for production of peacetime electricity at Oak Ridge, Tenn.*

This is one of the greatest challenges ever laid on the doorstep of an American enterprise. Monsanto scientists have accepted it with confidence. Late this year or early next, they believe, the unit will give forth its initial surge of electricity, marking the true beginning of a new era.

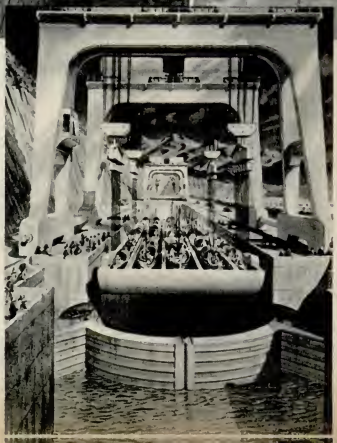
Your Pin-Up

**REPUBLIC RAINBOW.** Fastest passenger transport, the 51-ton Rainbow can carry 46 passengers from coast to coast in slightly over six hours, at a ton-mile cost of 12.5 cents. Externally identical with its military prototype, XF-12 (above), the Rainbow will cruise at more than 400 m.p.h. at 40,000 feet. Comfort is assured by pressurized cabin maintaining 8,000-foot atmosphere, ample lounge, smoker, and buffet accommodations. Power comes from four Pratt & Whitney engines developing 13,000 hp. Jet thrust assist, utilized commercially for the first time, adds 200 hp. per engine at high altitudes as the exhaust gases rush from the elongated nacelles. Rainbow is 100 feet long with 129-foot wing spread. Range is 4,100 miles with full load.

Gigantic gantry cranes (above) and hydraulically operated locks (right) are included in Yangtze plans. Cranes would lift whole ships, move them along tracks, and plunk them back into the water of farther navigation channel.

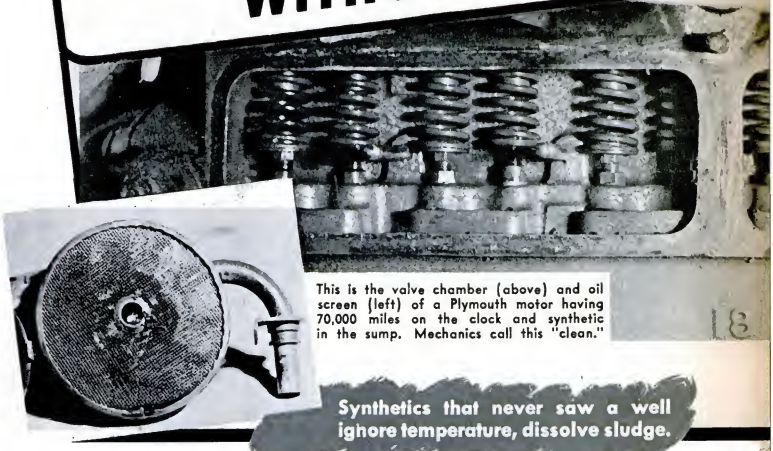
# CHINA'S DREAM DAM

BIGGEST irrigation, power, and flood-control dam on earth is projected for China's Yangtze River about 300 miles east of Chungking. Dam will impound water to irrigate 10,000,000 acres. Hydroelectric plant will generate three times power of Boulder, Grand Coulee and Shasta plants combined. U. S. is helping China's National Resources Commission with plans.



Gantry cranes that may be used to get ships past the Yangtze Gorge dam would lift or lower them 550 feet. Dozens of sampans would be handled at once in a corrugated boat tank. Hulls of large vessels would have to be reinforced.

# Lubrication WITHOUT OIL



This is the valve chamber (above) and oil screen (left) of a Plymouth motor having 70,000 miles on the clock and synthetic in the sump. Mechanics call this "clean."

**Synthetics that never saw a well ighore temperature, dissolve sludge.**

**By GOLD V. SANDERS**

NEW lubricants without a drop of petroleum in them—made by synthesis from natural gas—bring the production of an ideal motor oil much closer. The perfect lubricant would, of course, never have to be changed, would provide easy starting on the coldest morning and equally good lubrication on the hottest day. It would not produce carbon, sludge, or other waste products that foul working parts and reduce the smoothness (lubricity) of the oil itself.

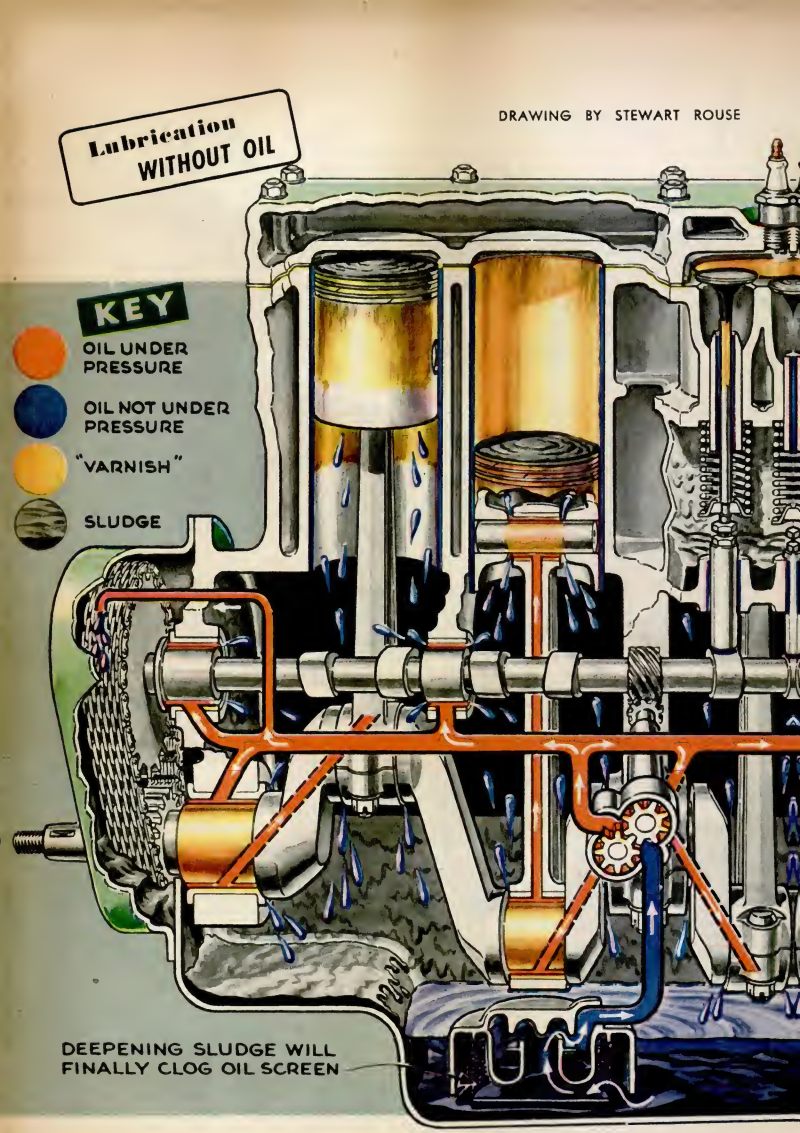
Synthetic oils, highly developed during the war and given extensive tryouts by Army Ordnance and the AAF, are able to maintain a remarkably constant degree of viscosity no matter how the operating temperature varies. The same oil may be used in winter and summer.

Since synthetic oils differ from petroleum oils chemically, in particular, the oxidation that takes place in an internal combustion motor has a different effect on them. The waste products are mostly volatile compounds, which pass out through the exhaust pipe or crankcase ventilator. The waste products of petroleum oils are largely solids that remain in the oiling system,causing carbon and sludge that dirty a motor and reduce its efficiency.

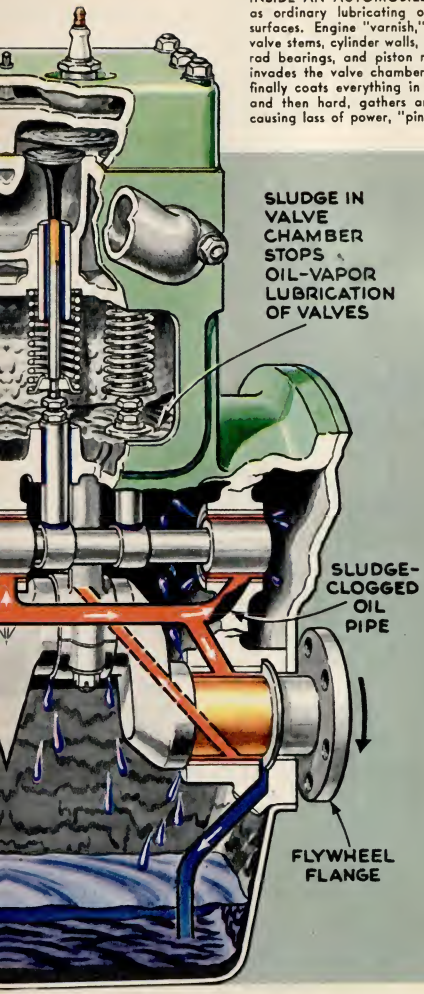
When the synthetic oil is put in a motor already fouled by petroleum waste, reports show, it tends to clean the motor slowly by dissolving accumulated carbon and sludge. Synthetic and petroleum oils may safely be mixed in the crankcase of a clean motor, but that is not recommended for dirty motors.

A 24,000-mile laboratory test of high-grade petroleum oil and synthetic oil revealed that after 2,000 miles the engine using synthetic oil was only 2.3 percent cleaner, but after 18,000 miles it was 20.1 percent cleaner.

Prestone Motor Oil, a synthetic lubricant produced by Carbide and Carbon Chemicals Corp., is made in a number of grades for varying purposes. Grade LB-300, designed for use in the average passenger car, has been on the market in limited distribution at 75 cents a quart. Standard tests have shown that this one grade provides adequate lubri-


Lubrication
WITHOUT OIL
DRAWING BY STEWART ROUSE
KEY
OIL UNDER PRESSURE
OIL NOT UNDER PRESSURE
"VARNISH"
SLUDGE
DEEPENING SLUDGE WILL FINALLY CLOG OIL SCREEN

INSIDE AN AUTOMOBILE ENGINE. Here's what happens as ordinary lubricating oil is splashed over the working surfaces. Engine "varnish," a by-product of oxidation, coats valve stems, cylinder walls, pistons, main bearings, connecting rod bearings, and piston rings, making them sticky. Sludge invades the valve chamber, interfering with lubrication, and finally coats everything in the crankcase. Carbon, first soft and then hard, gathers on piston heads and valve heads, causing loss of power, "ping," sometimes pre-ignition knock.




cation under a range of conditions that would require three grades of petroleum oil (S.A.E. numbers 10, 20, and 30). Grade LB-300 has a pour point of -40° Fahrenheit, at which petroleum oils would be a solid mass, and this means easier starting on cold mornings.

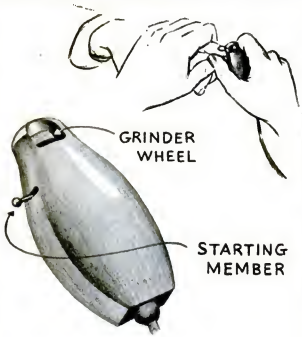
These findings were reported to the Society of Automotive Engineers by three engineers of Union Carbide and Carbon Corp., which developed the products. Synthetic oils now have been tested for four years.

The engineers do not claim a lower consumption rate for the new kind of oil, though standard tests indicated a margin in its favor. They emphasize, however, that the oil left after part has been burned and dissipated is still usable, its lubricity little impaired. By adding to it as it is consumed, they say this oil could be used indefinitely, except that other things besides oxidation products contaminate motor oil. Outside dirt finds its way inside motors, leaded gasolines leave some deposit in the oil, and metal particles from the working parts usually accumulate gradually. Barring external contamination, the engineers maintain, the period between oil changes could safely be doubled by using the synthetic lubricant exclusively.

These synthetic lubricants are strictly American achievements, the result of 15 years' research. Germany developed synthetic oils, too, during the war but comparisons made by scientists sent into the Reich on the Army's heels indicate that the Germans' oils were chemically different and inferior. The producers, however, do not promise any sizable cut in the present prices. The raw material, natural gas, is plentiful and cheap enough, but the process of synthesis costs considerably more than the production of petroleum oils.

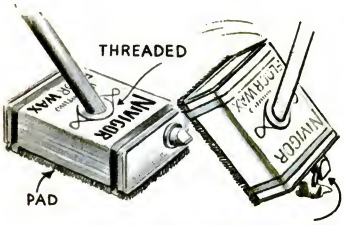
# NEW IDEAS

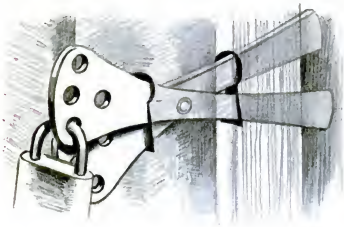
**Look! No Hands!** For mail carriers, gardeners, and others who must work under the summer sun, Benjamin B. Levine, of Pittsburgh, Pa., has devised a parasol that can be worn like a hat, leaving the hands free. Opened like the conventional sunshade, it has self-adjustable ribs that extend downward and are connected to a head band. This is adjustable to a number of head sizes, and may be mounted on a helmet or other headgear.




**Electric Manicurist.** An electric motor housed in a casing that fits snugly in the palm of the hand spins the grinding wheel of this nail file invented by H. Harris, New York City. You plug it in any outlet, trip the starter knob, and then hold the nail at the groove for filing. It can also be used for buffing.

**No Bending, No Stooping.** You soon may give your floors a gleaming wax finish and do the whole job standing up. Contrived by A. T. Rogovin, of New Haven, Conn., the combination container-applicator (below) has a long wooden handle that screws into the can of wax. The user tips the can slightly to spill some liquid and then spreads and polishes with the pad that is fixed to the container.

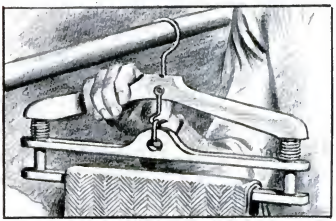


**Keyhole Guard.** A pair of identically shaped blades suitably inserted in a keyhole will defy anyone to force them out, claims inventor O. J. Lofqwist, of London, England. A padlock attached in holes of the wide ends, as above, keeps them open so that they cannot be pushed through or pulled out of the opening.

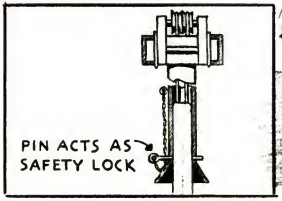
# FROM THE INVENTORS

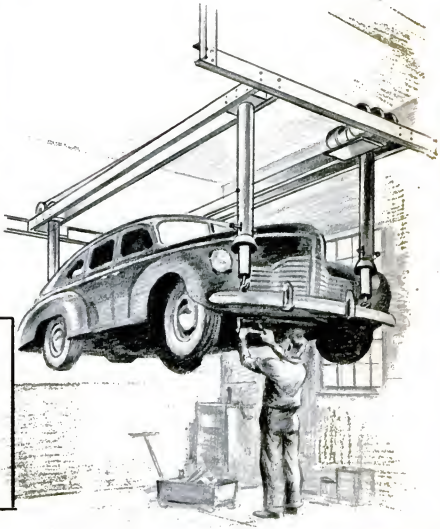
**Pinning the Pants Up.** The garment hanger below, designed by H. R. Ellis, of Meadville, Pa., keeps trousers from falling onto the closet floor. When pants are looped over the lower bar the hook is released from the eye on the upper bar, which is forced down by springs on the dowels, clamping pants in place.



**Compact Refrigerator.** The L-shaped electric refrigerator above can be hung on a wall or stood on a table. Within the shelf-like projection at bottom are the ice-cube trays. The motor is installed in the bottom rear, with the main food compartment above it. Cooling coils run inside the rear and side walls. Donald E. Dailey, Germantown, Pa., is the inventor.

**Automobile Hoist.** All parts on the underside of a car are easily reached and the working space beneath the car is completely cleared for the movement of workers and their tools when the hoist invented by Elmer B. Thompson, of Des Moines, Iowa, is used. Instead of the conventional mechanism rising from the floor, the new hoist has four shafts that come down from an adjustable frame suspended from ceiling beams, to pick up the car by its four corners. A safety lock (below) guards against hydraulic failure.



# WINGS on the WIND

**Soaring, a scientific study in powerless flight, resumes its place as a leading peacetime sport.**

Sailplane has sensitive variometer instead of power plane's rate-of-climb indicator. Clockwise, instruments are variometer, altimeter, turn-and-bank indicator, watch, air-speed indicator, compass (center).

Knocked down and loaded on its special trailer, a sailplane (below) is transported to launching site.

WARM days of spring and summer are reviving the sport of soaring flight, curtailed during the war. Invasion gliders used by U.S. and British troops could go in only one direction when they were released by their towing planes. That was *down*. A soaring plane *climbs* without power. Sailplanes (high-performance gliders) in soaring flight have traveled as far as 465 miles cross-country and have reached altitudes over 20,000 feet.

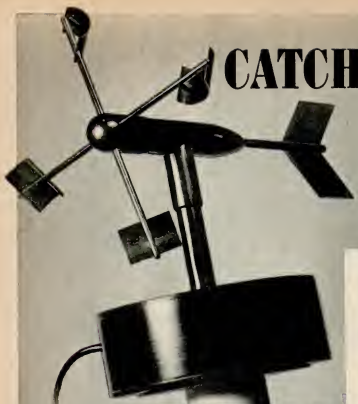
Such performance is due to the "cleanliness" of their design—they are the world's most streamlined passenger aircraft—plus wing construction that permits them a high "gliding angle." That is, the best of them loses only one mile of altitude for every 20 miles of forward flight. Combined with this is a low "sinking speed," or the amount of altitude they will lose each second in motionless air. A good sailplane sinking speed is three feet a second.

Sailplane launching and the ideal conditions and some of the hazards of flight are graphically shown here. Soaring is not an inexpensive sport, but it is one of the most fascinating.

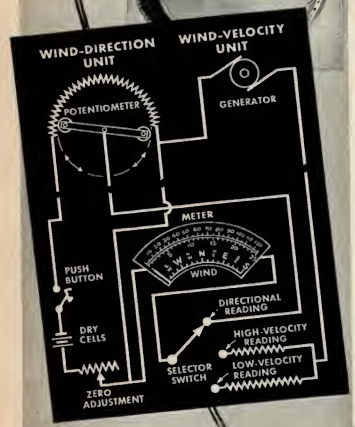
CUMULUS
A thermal is a warm updraft, and is indicated by a cumulus cloud. Warm air expands, and as it does its pressure decreases. Cold air flows toward this area, forcing warm air upward. Going up, air is chilled, loses some moisture, and cumulus cloud is formed.
Towing is best launching method. Sailplane releases when tow plane is lifted by a thermal.
Drum, or winch, launching zips a sailplane about 1,000 feet before the cutoff. Then plane steers toward a slope to take advantage of upward-moving air caused by wind striking ridge.
SOARING SITE AT FOOT OF RIDGE
START
RELEASE
WINCH
WIND DIRECTION
Weather-wise pilot finds strong upcurrents in a "cold front." Rising warm air holds plane up.
COLD AIR
Soaring conditions are good over water. Water-warmed ascending air provides ample "lift" for gliders.
COLD AIR
WARM WATER
Here, obstructions cause the normal slope wind to become turbulent. This gives pilot less lift, rough ride.

# CATCHING the WIND on a DIAL

## Inexpensive Instrument To Serve Small Airport



Gears at right in the base of weather vane signal wind's shifts to the potentiometer.




Hastings' potentiometer has two arms, to cope with sweeping wind changes. Both ends of the resistance unit and voltmeter scale, therefore, are South.

THANKS to a young Yankee inventor, the average weather enthusiast will soon be able to tell how hard the wind is blowing and from what direction without stirring from his comfortable chair by the fire. John A. Hastings, of Bass River, Mass., has devised an inexpensive anemometer-weather vane that uses simple electrical circuits to transmit information about the wind from the roof to a dial anywhere in the house.

The Weather Bureau's intricate wind-measuring instruments cost up to $1,200 apiece. Hastings' apparatus, accurate enough for airports and yacht clubs, will cost $100 or less.

On his invention, the whirling arms of the anemometer are tipped with curved blades instead of the usual hollow hemispheres. The arms drive a compact generator inside the body of the vane, and the generator's output, an accurate indication of wind speed, is measured by a voltmeter connected to the generator. To cut costs, Hastings uses one voltmeter, calibrated in miles per hour and points of the compass, to measure both wind velocity and direction.

Recording the wind's direction on the dial is harder to do, but Hastings found a relatively simple way to accomplish this. As the vane swings, its shaft turns a gear below. This gear meshes in a 1:2 ratio with another, which moves the revolving arm of a potentiometer—one degree for every two degrees that the wind veers. The potentiometer is in series with a couple of dry cells and the voltmeter. As the arm moves it varies the resistance in the circuit and causes the voltmeter to record a variation in voltage drop—actually, a change in the wind's direction.

By pressing a button on his voltmeter, Hastings cuts it into the proper circuit to give wind speed or direction.

At the scene of an accident, police officer takes movies of the position of the cars.

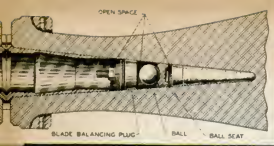
Microphone just inside car hears what witness says when he is questioned by police.

Even the tone of voice is on record at headquarters.

# Audible POLICE Blotter

SOUND MOVIES give the Los Angeles police an additional means of recording automobile accidents. Communications equipment from B-29s is now in use in patrol cars.

Officer inspects the thin acetate record of a witness's evidence.




Vibration absorber was first placed in prop's butt and (left) but its present position (directly below) is more effective

## Bouncing Ball in Prop Reduces Vibration

AN EIGHT-OUNCE steel ball, bouncing up to 230 times a second in a tiny socket inside a whirling hollow-steel propeller, sets up forces that reduce by half the vibrations that engine firing action produces in the blade.

At left, Hamilton Standard's Engineering Manager, Erle Martin, points out the ball's socket to Rear Adm. H. B. Sallada, Chief of the Bureau of Aeronautics, and Rear Adm. L. C. Stevens. When the vibration absorber is installed it is covered; only a slight lump locates the ball.

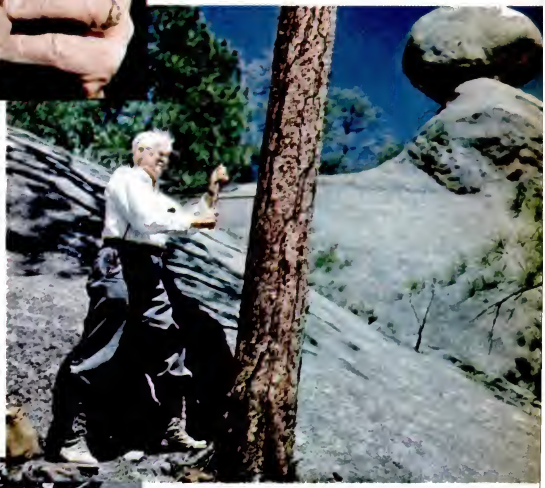
## Modern Trumpet for Deaf Is So Tiny That an Earring Conceals It

A HEARING AID hidden in an attractive earring is the latest device to disguise a woman's deafness. "Hearrings," as they are called by the manufacturer, Maico Co., of Chicago, naturally come in pairs, and designs are interchangeable. A transparent, almost invisible plastic tube, molded to suit the individual, carries sound from the receiver earring to the ear.

Devices to help men, especially veterans, to hear have also been receiving attention. Harvard's Psycho-Acoustic Laboratory has done basic research on an "ideal hearing aid."

# *Almanac* in the Woods

Dr. Andrew Ellicott Douglass studies tree rings and discovers from them the trend in rainfall over periods of centuries. Thin or fat rings tell the story and furnish a basis for predictions. Here Dr. Douglass examines rings with 10-power magnifying glass.



The doctor uses a Swedish increment borer, a hollow auger for cutting out a core from a living tree to make an estimate of its age by counting the annual growth rings. This test shows development; is most valuable if used when the tree is small.

Slight differences in tree rings add up to important deductions as to rainfall and the varying growth of trees. Here is shown the use of a tree-measuring engine, a precision instrument that measures variations of 1/100 millimeter. It helps predict rainfall.

TO the many scientific yardsticks contrived in recent years to disprove Mark Twain's charge of universal concern but general neglect over the weather now is added a new barometer as old as life. Airplanes, balloons, cameras, radar and a dozen other instruments of weather data collection are joined by the tree.

Dr. Andrew Ellicott Douglass, 78-year-old astronomer and physicist who looks a bit like the author of "Huckleberry Finn," is predicting weather conditions for years ahead by studying tree rings. He is conservative in his claims for forecasting by dendrochronology (tree time), but one of his latest achievements bodes well for mankind in its unceasing struggle with drought and storm. (*Continued on page* 110)

Under pressure for increased World War II production, Boulder Dam's hydroelectric engineers said they could increase power output, but not without dangerously depleting the water reserves behind the dam whence comes the water that spins the power-producing machinery. Millions of people depended on that water, and there had been unusually little replenishing rainfall for 20 years.

At the Tree Ring Laboratory of the University of Arizona in Tucson arrived a station wagon, a driver, and unlimited gasoline-ration coupons. Dr. Douglass made a 10,000-mile tour of the Colorado Basin, studied tree rings, and reported:

"Twenty dry years have passed. That drought period is most unusual in the last 500 years. The drought will probably break."

Increased power output at Boulder was ordered, new machinery hummed, the war was shortened. The next year rainfall was unusually heavy!

In bringing the new science toward perfection, Dr. Douglass simply makes "weather stations" out of trees. Each year a tree grows a new outer layer, called the cambium layer. This sheath is a circlet of long slender tubes that carry a tree's chief sustenance—water—upward. At the end of a year, these tubes die, are encircled with new tubes, and the cycle begins anew. A tree handicapped by a year of intense drought will produce a very thin ring; in a year of plenty the ring will be fat. Looking at the cross section, the weather during the tree's life—two to 500 years for pine or fir—can be read. Weather records for the area will agree, year for year, with the wooden calendar. Width of an individual ring and the number of inches of rain for that year can be reduced to a mathematical proportion, and the centuries-long weather index of the tree may be read.

Dr. Douglass does not claim that this means the antics of weather can be charted exactly for years ahead. It does mean, he contends, that trends can be established. He says: "When we have available enough tree-ring weather records from all parts of the world to get an accurate picture of what the weather has been for centuries, I have great hopes that we will be able to derive from them more definite indication of what it will be for scores of years in the future."

Dr. Douglass believes the enigma of future weather is linked with tree rings and solar activity. He sees in sun spots—the phenomena caused when cold masses sweep through the hot, gaseous surfaces of the sun—the cause of the earth's weather tides. These sun spots have a peculiarly rhythmic record. They last about 11 years. At the beginning, the solar twister appears with a few small spots about halfway between the sun's equator and its poles. The spots increase slowly in numbers, then rapidly, and spread widely toward the sun's equator following which they largely disappear. Then with remarkable regularity, the cycle begins again. This eerie cosmos Dr. Douglass has found to be related to the cycles of world's weather as evidence of tree-ring patterns.

Complete success of forecasting by dendrochronology would bring revolutionary benefit to man. Every branch of commerce and industry would be affected. Living would be changed, made easier and less expensive.

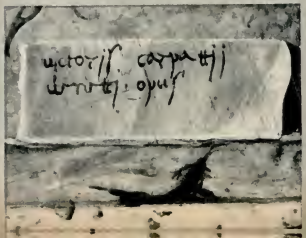
Dr. Douglass points out some of his findings on a section of a sequoia, and shows how they predict weather.

A chart of a century or more of weather is revealed by this cross section of a large tree, with the width of the rings as an indication of the rainfall absorbed during each year.

"Meditation on the Passion" was signed by Andreas Mantegna (as the photo below shows) but art experts believed Vittore Carpaccio actually painted it. Infra-red photography proved that they were right.

# New Light on Old Masters

The first infra-red photo vaguely but unmistakably revealed Carpaccio's signature two layers of paint below Mantegna's. After overpaint was removed, it showed up clearly (below) in a second infra-red photo.



By HARTLEY E. HOWE

THANKS to science you can see the world's great paintings in the same glowing colors used by the masters who painted them centuries ago. New formulas and plastics at New York's Metropolitan Museum of Art bring old masters back to the bloom of youth and keep them that way. The microscope and X ray reveal details of how the painter worked. Chemical analysis helps date a picture accurately—and sometimes discovers a fake identification.

When a picture comes to the Museum's painting clinic, the brushwork and paint structure are first studied under the microscope. Microchemical analysis of tiny pieces of pigment or base, taken from the edges, gives further data. To learn what is beneath the surface, X-ray pictures are taken by the traversed-focus technique, providing a shadowgraph of the entire paint structure. Photographs made with less penetrating infra-red rays lay bare the secrets of the intermediate layers of paint: how the artist repainted parts of the picture. Information about the top layer of all.

The original, fervent colors of El Greco's "View of Toledo," painted 300 years ago, come to life where the famous canvas has been cleaned by an acetone.

the varnish, is gleaned from ultraviolet examination; fluorescent areas frequently show where the varnish has been patched.

The experts next turn their skill to preserving the painting. Old varnish is removed with special solvents and the picture is gently cleaned. Loose paint is carefully reattached. Damaged areas that mar the picture may be minimized by careful filling in with new paint, but no attempt is made to "restore" the picture to its original condition. New backing reinforces the wooden panel or canvas. Finally the surface is given a thin, invisible, protective coating of polyvinylacetate. Sprayed on, this synthetic plastic resin remains permanently colorless and clear, unlike varnish, which darkens, becomes brittle and often shrinks.

Measuring the distance between cracks in a painting is one of the first steps in treating it at the "Met."

Assistant Curator Murray Pease wraps painted panel, laid face to face with X-ray film, in light-tight paper. It is done in the dark.

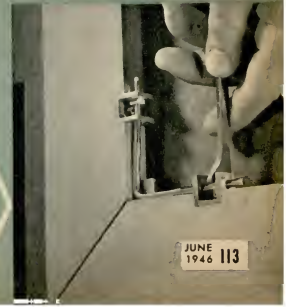
Painting and film are whirled on turntable as X ray is taken. A clearer radiograph is obtained by using this medical technique.

After varnish has been removed, Curator Pease cleans painting with a swab dipped in special detergent. Dark square is grime.

Replacing loose paint. The surface is heated with an infra-red bulb and adhesive is worked down through the cracks with an iron.

New linen is attached to back of painting by forcing a wax-resin thermoplastic (Museum formula) through to paint's underside.

On the 5- by 9-foot bed of this Museum press, jacks hold the painting flat while its relining adhesive sets.



Painting is remounted on a stretcher frame, specially constructed. Threaded bolt devices at the corners provide just the right tension.

*Photos by*
HUBERT LUCKETT

# COLOR PRINTS *from your*

NEW discoveries in color printing have now brought that phase of photography well within the scope of the home darkroom. Contact color prints can now be made with no special equipment, and enlargements are possible with an ordinary condenser or diffusion-type enlarger. The entire process requires but an hour and a half, only the first 15 minutes of which need be spent in darkness or with a green safelight.

Essentially the simplification in color printing is due to a new printing paper—Ansco Color Printon. With it the amateur can print in much the same way he does in black and white. It eliminates many of the tedious steps of older processes, such as the making of three separate negatives, the preparation of three positive images in color from them, and the transferring of the color images to paper.

No one should assume, however, that all he need do is to obtain a supply of this new material and retire into a darkroom with his chemicals and the first color transparency that comes to hand. Just as in black-and-white work, knowledge and experience must be gained before really good prints will result. The amateur must first learn the few fundamentals of the new process and how to recognize the type of color transparency most suitable for color pictures.

Ansco Color Printon consists of three light-sensitive emulsion layers coated upon a single flexible white opaque base. When it is exposed by light passing through the color-film transparency, blue light registers in the top emulsion, green light in the center emulsion, and red light in the bottom emulsion nearest the opaque base.

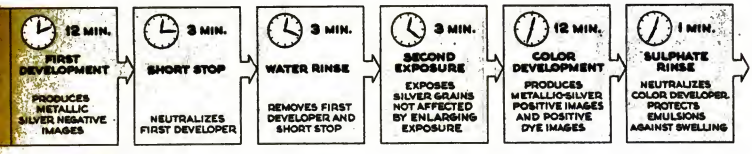
A No. 212 enlarger lamp 2' away gives the second exposure. Examine print through filters to find which to use.

Each emulsion layer contains chemicals that form dye images during processing. After the processing, each layer contains a dye image of a color complementary to that of the light by which it was exposed. That is, the top layer contains a yellow dye image, complementary to blue; the center layer a magenta image, complementary to green; and the bottom layer a cyan, or blue-green, image, complementary to red. These complementary dye images filter light reflected from the white base, and the picture is seen in natural color closely approximating that of the original subject.

Developing is by reversal, a method comparable to that of processing home-movie films. All the steps in the developing procedure and the time required for each are shown in the drawings below and on the facing page. Processing may be done in trays or on individual sheet-film hangers suspended in tanks of any convenient size. Tanks or trays of glass, bakelite, hard rubber, or enameled steel are suitable.

Since eight processing solutions are used, nine trays or tanks—eight for solutions and one for washing—provide maximum convenience. But if space or equipment is limited, processing can be carried out quite easily with only three trays.

There is little opportunity for error in processing if the steps listed in the series of drawings are followed carefully. In selecting the transparency to be printed and in exposing it, individual judgment must be exercised just as in black-and-white printing. Choose color transparencies that have been correctly exposed and processed (see PSM, Feb. '46, p. 104). Prints of top quality cannot be expected from transparencies that are dark or dense from



# *own enlarger*

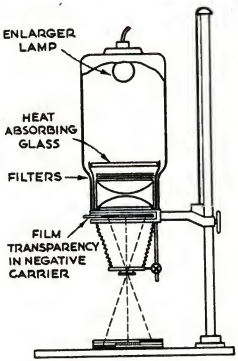
By KENNETH S. JOHNSON

underexposure or weak and washed out from overexposure. Avoid also transparencies having excessive contrast. Deep shadows and clear areas lacking in detail are more objectionable in a print viewed by reflected light than a transparency viewed by transmitted light.

Amateurs familiar with color photography know that color films are balanced in manufacture to give suitable color reproduction when exposed in light of a definite color quality. If the film is exposed under other lighting conditions, it is necessary to use filters to achieve correct color balance in the transparency. A comparable principle applies in exposing Printon either by contact or in the enlarger. The basic light must be of the approximately correct quality for transparencies of normal color balance, and it is adjusted to individual conditions by means of filters.

Standard for Printon are a No. 212 General Electric photoenlarger lamp, a sheet of heat-absorbing glass, and an ultraviolet-absorbing filter. The heat-absorbing glass protects the transparency from damage from heat of the lamp, and the filter absorbs unwanted ultraviolet rays. A standard lamp may be installed permanently in the enlarger since it is suitable for both color and black-and-white printing.

Ansco color-compensating filters may be used for making any necessary adjustment in the color quality of the standard enlarger light. A complete set contains three yellow gelatin-filter foils (Nos. 23, 24, and 25), four magenta (Nos. 33, 34, 35, and 36), and three cyan (Nos. 43, 44, and 45).




Here is the setup for the enlarger in making color prints. Light passing through the transparency acts on just the one proper emulsion layer in the three-layer material. A glass stops heat, and filters correct color.

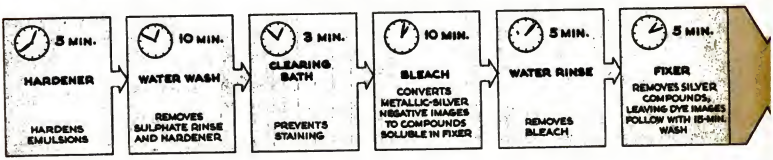
The first step is to balance the color quality of the light. Once this is done, no further experiments should be necessary as long as transparencies of normal color balance are used.

Select a good transparency of normal color balance for a test and place it in the negative carrier with its base, or shiny side, toward the enlarger lamp. Adjust the enlarger until a sharp image of the desired size appears on the easel. Then make a test strip or print exactly as is done in black-and-white printing, using one of the extra sheets of Printon provided in each package for this purpose. Each succeeding section should be given an exposure twice that of the preceding section. The speed of Printon is slightly less than that of fast enlarging papers.

If you have a photometer of the grease-spot type, it can be used to estimate exposure of a test print by reading an important highlight area of the transparency such as the flesh tones of the face in a portrait subject. The paper speed number to be used will depend, of course, upon equipment, processing methods, and the photometer used. Either test strips or test prints serve as a future guide to both exposure and color balance.

The proper exposure is easily determined by examining the over-all density of the test piece. An area showing satisfactory density, regardless of color quality, has received correct exposure, and the time used for the test can be used for the final print unless filters are added.

Any necessary change in color quality of the light will be indicated by the correctly exposed



section of the test. If color is satisfactory, nothing further is required, but if there is an over-all coloration, a filter will be needed. One way to determine which to use is by examining the area through the various filters in your kit. The one or combination that gives correct color quality should then be added to the optical system of the enlarger.

As a guide in selecting filters, the general rule is to use one that supplies the color lacking in the print. For instance, a print having an over-all bluish cast is lacking in yellow, the color complementary to blue, and a yellow filter of the proper degree should be used. For an excess of magenta, correct with cyan and yellow filters; for cyan, use magenta and yellow; for yellow, magenta and cyan; for green, magenta; and for red, cyan. It is also necessary to overcome inequalities in color balance of abnormal transparencies.

Each filter absorbs some of the light passing through, and the basic exposure must be increased when filters are added.

Colors show up in the print as naturally as they do above. At the left in the drawing are the three primary colors recorded during exposure; at the right are the dye images of the three subtractive primary colors formed by processing. The base reflects light.

Filters with numbers ending in 3 call for a 15-percent increase, those with 4 for a 30-percent increase, and those in 5 for one of approximately 60 percent. If, for example, Nos. 23, 34, and 45 filters are all used, the exposure must be just about doubled.

In general, any ordinary negative-drying method is suitable for color prints. Rapid drying by fan helps keep the whites clean.

Dry-mounting tissue is unsatisfactory. Rubber cement works well on plain salon boards. On mat mounts or cutout desk folders, the upper corners are taped.

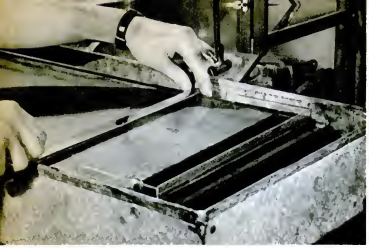
# Measuring the INVISIBLE

Yellow-brown band on Blodgett gauge (at top) is 2/1,000,000 inch thick; each succeeding strip to left is 2/1,000,000 inch thicker. Density of oil film is judged by the gauge's complementary colors.

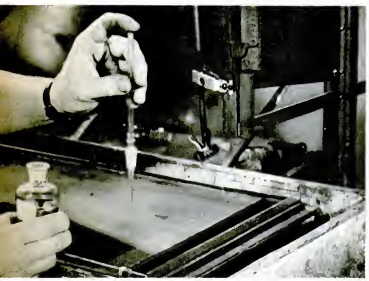
**Color gauge that had scientists stumped for centuries determines thicknesses of 1/250,000,000 inch.**

FOR centuries scientists have known that the colors of thin transparent films had nothing to do with pigment, but were due to an optical effect directly related to the thickness of the film. But it was only recently that a practical gauge, making use of this trick of light, was devised. Using the same principle, gauges that suit special requirements can be made that would indicate a thickness of *1/250,000,000 inch!*

While investigating the behavior of oil films so thin that they were absolutely invisible, Dr. Katherine B. Blodgett of General Electric placed a drop of stearic acid on the surface of a trough of water containing calcium carbonate. By reaction with the calcium, it quickly became an ultramicroscopic layer of calcium stearate. Then she found she could build up successive layers of the film on a glass slide and



Coatings for gauge are "picked up" off the surface of distilled water containing calcium, barium, or cadmium. Metal rod first scrapes water free of oil.



Drop of stearic acid spreads over the surface to form a film 1/10,000,000 inch thick. Chemically clean glass slide then is clamped to dipping arm.

that 21 layers reflected a yellow-brown color, 41 showed a dark purplish-blue, 61 a brilliant light blue, and so on. With each layer, the film showed a visible change in hue. Now, anyone who wishes to measure the thickness of any film within its range needs merely to compare the color of his film with the nine color steps on the gauge.

Already, research with this gauge has brought important results. Most spectacular was its aid in developing nonreflecting, or invisible, glass, which made clearer the "seeing" of aerial cameras, range finders, and submarine periscopes during the war. Films of calcium or barium stearate, built up on lenses and prisms to a depth of 4/1,000,000 inch by the dipping method, effectively killed the reflection of most visible light from their surfaces. Today, most films for coating nonreflecting glass are made by vaporizing some fluoride onto the surface of the glass, but the color of the coating, when it has attained the correct thickness, can still be determined by comparison with the gauge.

With this instrument, metallurgists can tell the thickness of an oxide coating on many metals merely by comparing colors. Another use has been in the study of the size and nature of different proteins.

The colors of oil films on water are not the same as those shown by the Blodgett gauge, but are their *complements*. This is because water has a lower refractive index than the oil film floating on it, while glass (of the gauge) has a higher refractive index than the films adhered to it.

Slide goes down and is pulled out 10 times, taking on coating 2/1,000,000 inch thick. With adjustments and more dippings, nine color bands are made.

Looking colorless and transparent, slide is coated on one side with black paint. Held to white light at 45-degree angle, it is an exact thickness gauge.

# I'D LIKE TO SEE THEM MAKE...

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? Popular Science Monthly will pay five dollars for every such suggestion published.

**False-alarm Deterrent.** When you pulled the lever in a fire-alarm box, a mechanism would hold your hand there until the engines arrived. Then you would direct firemen to the blaze. The idea comes from Alvin Teitelbaum of Brooklyn, N. Y.

**Economy-size Cigarette.** Half standard length for the convenience of the addict who has leisure for only a couple of drags at a time. A. Armstrong, Missoula, Mont., is the originator of the plan.

**Soft-spoken Rouser Clock.** A gentle phonographic attachment that would waken a sound sleeper without jolting him suddenly. Harvey Ackerman, of Brooklyn, N. Y., would like to see them make it.

**Money Changer for Parking.** Embarrassment of having no nickel for parking meter would thus be saved, thinks Willie Muessig, of Aurora, Ore.

**First Aid to Aching Feet.** A folding stool or chair that could be carried in one's pocket or handbag. It should be capable of quick and easy assembly for use by those who have to wait in theater queues, nylon lines, or other places where there are long delays and seating accommodations are not provided. The chair should be made of some lightweight material that will stand up under the average person's weight. The suggestion was made by Miss Ocala D. Hales, of Raleigh, N. C.

## Three Projects of the Month for Craftwork Hobbyists

George Washington rode here—or did he? The histories don't agree on whether the coach at Mount Vernon is an exact duplicate of the First President's, but it was the model from which this mantel-size one was designed. Drawings and a description of how to build the 5½" by 10" mantelpiece coach are given on page 176. The body is wood, fittings are metal, and seat coverings velvet.

Aromatic red cedar and tea tiles are combined to make the serving tray shown at left. The tiles are set in routed recesses and are useful as well as ornamental, since they permit the carrying of hot teapots and the like without marring the wood. End compartments hold glasses or silver. Construction steps are on page 163.

Something different in chessmen was the idea behind the designing of this set. All pieces are made entirely in the lathe, being turned from 1" hardwood doweling, as described on page 174. The base coat of enamel is also put on in the lathe with the spindle rotating slowly.

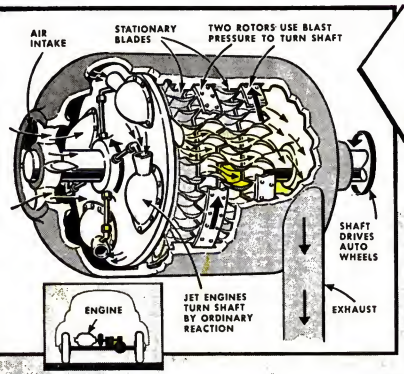
# GAS TURBINE for AUTOS

A GAS turbine not much larger than the bulge in the rear-axle housing of present cars may be the auto engine of the future. A simplified jet designed by Robert Kafka and Robert Engerstein, of Carney Associates, New York engineering firm, has made this possible. They estimate that a compact 100-horsepower turbine can be built to deliver 40 miles to the gallon from low-grade gasoline or kerosene.

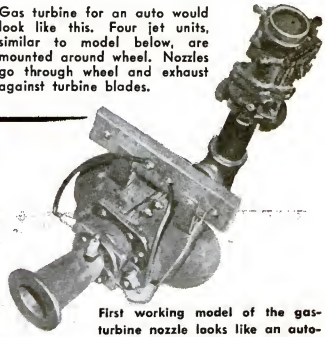
Their turbine has two main parts—the jet units and the turbine wheels. Each jet has two combustion chambers, which alternate in firing at 30 or more pulses per second.

Four jet units are mounted around a wheel in the gas turbine. In operation they have a pinwheel effect on this wheel. Pressure from the expanding jet gases drives the turbine blades. About half the power from the gas turbines used in aircraft today goes to drive a supercharger, but no such drain on power is necessary in this engine. Eliminating the supercharger also allows the turbine to be throttled. A simple carburetor regulates the fuel-air mixture.

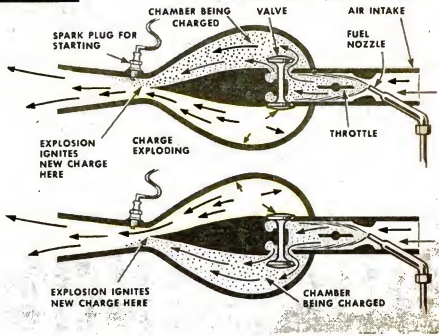
Several other conventional automotive units are used with the turbine. A cranking motor spins it over for starting and a spark plug furnishes the ignition needed for that purpose. Clutch and transmission give closer control over engine speeds. But the gas turbine is simpler than present auto engines. When further refinements are made, advocates believe that car manufacturers seeking simplicity in engines may find gas turbines their most practical answer.




Gas turbine for an auto would look like this. Four jet units, similar to model below, are mounted around wheel. Nozzles go through wheel and exhaust against turbine blades.



First working model of the gas-turbine nozzle looks like an automobile horn with puffed cheeks.



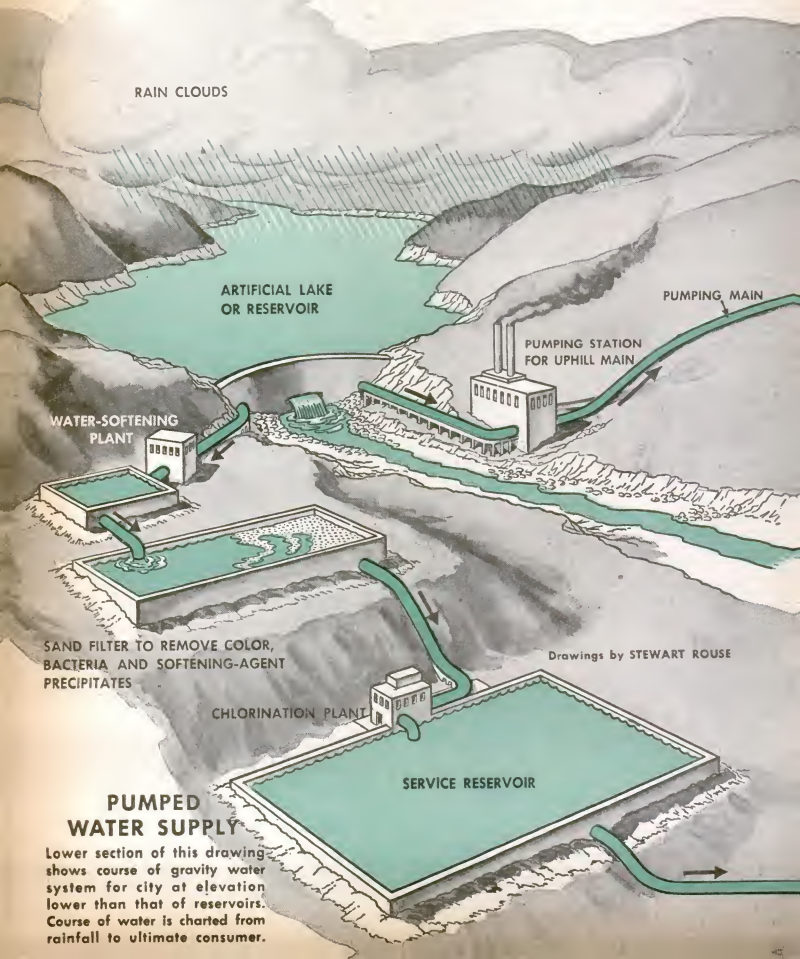

Firing one chamber blasts the valve shut, sends burning gases out the nozzle. As they pass the opening in the other chamber, they exhaust it, draw in fresh fuel.

Fresh fuel continues to fill that chamber until flame in the nozzle ignites it, blasting back into the chamber, shutting the valve, and repeating the firing sequence.

Mechanics of LIVING

# clouds to faucets

**The control, purification and distribution of water have made big cities possible.**



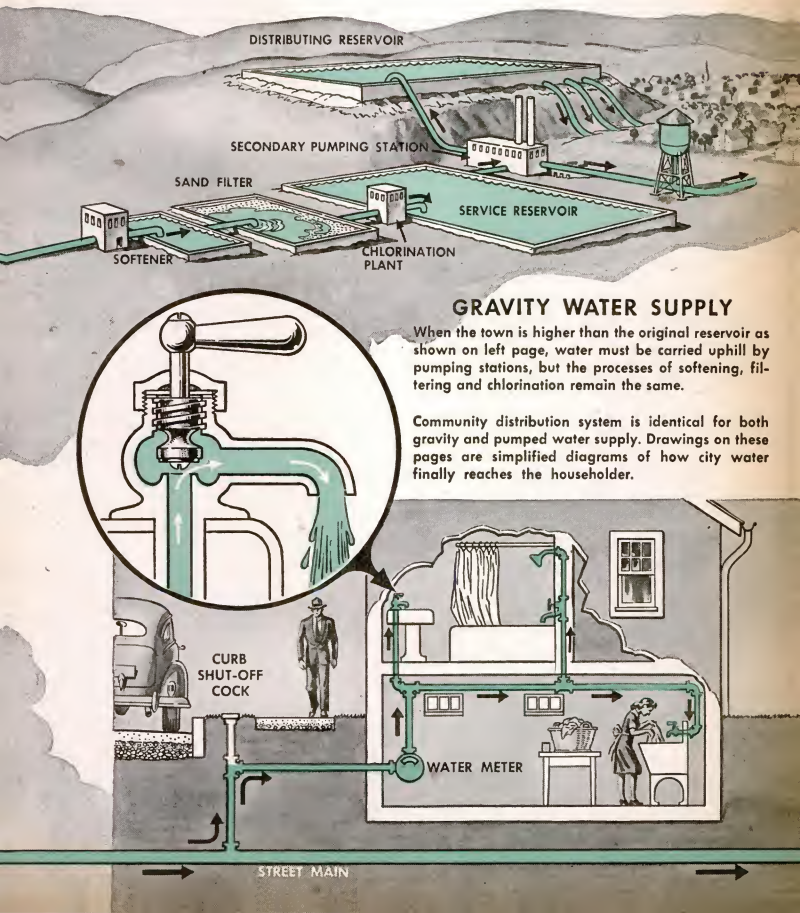

## PUMPED WATER SUPPLY

Lower section of this drawing shows course of gravity water system for city at elevation lower than that of reservoirs. Course of water is charted from rainfall to ultimate consumer.

THIRSTY people merely draw a glass of water from any convenient faucet. That is why we take water for granted.

But the water-purification techniques that have made it possible for our biggest cities to exist were developed comparatively recently. Water that could not have been considered for human consumption 15 or 20 years ago is now made safe. Two of the several standard systems of water supply are illustrated here from source to faucet.

Water-supply engineers have many problems to solve, but their objective is always to furnish an adequate amount of water that is clear, free of water-borne disease or chemical poisons, reasonably soft, of good taste and without properties injurious to metals used. Engineers must also provide devices to prevent interruption of service and to take care of such emergencies as fire. This often means duplicating mains, basins and pumping machinery.




## GRAVITY WATER SUPPLY

When the town is higher than the original reservoir as shown on left page, water must be carried uphill by pumping stations, but the processes of softening, filtering and chlorination remain the same.

Community distribution system is identical for both gravity and pumped water supply. Drawings on these pages are simplified diagrams of how city water finally reaches the householder.

# Superfuels *waiting for* TOMORROW'S CARS

**But a simple, practical engine to burn them is lacking.**

By GOLD V. SANDERS

THE motorist today is octane-conscious. He knows how his motor knocked and struggled when gasoline was reduced a few points on the octane scale during the war, and he noted with joy and relief how the old motor lost its ping-ping and perked up when those mysterious octane qualities were put back in his fuel. He has heard a lot about power-packed fuels created by the petroleum industry to boost the speed and range of warplanes. How about some of this 100-octane and better gasoline for his car?

Superfuels are ready and waiting. They could greatly increase the motorist's mileage per gallon and step up his car's power. All he needs is a reasonably cheap motor that can assimilate this rich new kind of gasoline and extract its power vitamins from it.

As built now, automobile motors generally get no more power from 100-octane than from 80-octane. Even if motors capable of digesting these superfuels were built tomorrow, the petroleum chemists would still be ahead of the automotive designers. They have gone far beyond the hundred mark in concocting new fuel blends and have had to invent a new scale of measurement because they ran clear off the octane scale.

But the difference between a modern airplane engine and the conventional power plant under the hood of a car is immense. Engineers who comprehend this difference shake their heads when asked how long it will take auto designers to catch up with the fuel available for their use. Some engineers doubt whether it ever will be accomplished.

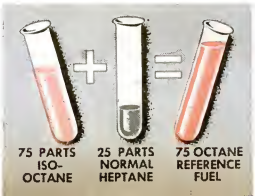
An automobile motor is built to a budget and to operate on a budget; warplanes were built almost regardless of cost to get the utmost in performance. The roaring giants that ate up the superfuels in bombers and fighters cost at least 10 times as much per horsepower as auto engines and had to be overhauled every 700 to 1,000 hours. Motorists cannot spend money like a nation fighting for its life.

To take advantage of higher-octane gasoline, auto engines must have higher compression ratios, or have the fuel blasted into them by powerful superchargers. The compression ratios of some automobile engines already are as high as those of the most powerful airplane engines, but in the latter the pressure is built up to about twice that of an auto engine's by the supercharger.

Is it practical to put such superchargers in automobiles and build all parts of the motor strong enough to withstand the increased pressure? That remains to be seen. A really efficient supercharger turns at seven to nine times the speed of the crankshaft, must be built to high precision, and costs a lot.

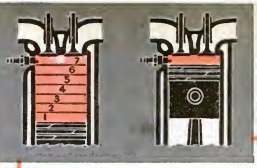
The motorist may have to wait a long while to use 100-octane gasoline, but he is already benefiting from wartime advances in fuel refining. Regular-grade gasoline in filling-station pumps all over the country averages 76.7 in octane rating now. This average was 75 just before the war and dropped to 70 during the war. Premium grade now averages 82.3; before the war it was 78 to 80 and its lowest war average was 75.8. Other important properties that give quick starting and rapid acceleration have been increased in proportion.

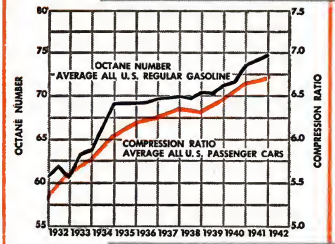
At war's end, the refineries were turning out more than 20,000,000 gallons of 100-octane gasoline a day. New techniques and the sacrifices in quality that

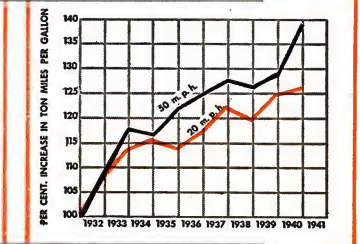



How octane rating is determined: iso-octane represents 100; heptane represents 0. A motor fuel with an octane number of 75 has an anti-knock quality equal to a mixture consisting of 75% iso-octane and 25% heptane

A compression ratio of 7 to 1 is diagrammed here. The volume of the air-gas mixture in the combustion chamber at the bottom of a piston stroke (left) is compressed to one-seventh at the top of the stroke (right).



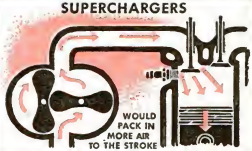




Compression ratios of stock cars have risen as the octane number of available gasoline has climbed, and mileage per gallon has kept pace.

## LARGER MANIFOLDS

WOULD PERMIT GREATER FUEL INTAKE

## SUPERCHARGERS



WOULD PACK IN MORE AIR TO THE STROKE

## LARGER VALVES

WOULD HELP HIGH-COMPRESSION MOTORS "BREATHE" BETTER

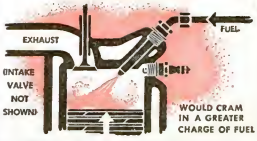
## HIGHER COMPRESSION

WOULD UTILIZE MORE OF THE POTENTIAL POWER OF HIGHER-OCTANE GASOLINE

## OIL-COOLING RADIATORS

MAY BE NEEDED BECAUSE OF HIGHER TEMPERATURES

## FUEL INJECTION




WOULD CRAM IN A GREATER CHARGE OF FUEL

**MOTORS MUST BE REDESIGNED** in one or more of the ways outlined above, before motorists can enjoy the benefits of higher-octane fuels.

were endured by civilians made this possible. Aviation now cannot use more than a tenth of this potential production, however, so the components are going into richer blends for auto engines.

Automotive and petroleum engineers say that the present grades of gas are more than good enough for today's motors. Only a few can get full advantage out of 80-octane or above. Many get as much power and mileage out of the regular grade as from premium grades. You might obtain some 100-octane gas from an air line or a refinery and put it in your car, but the result would probably disappoint you.

Octane rating means only one thing: the ability of a fuel to stand pressure and heat without detonating. The great gains in power that both planes and automobiles achieved during the past decade came almost entirely from the creation of gasoline with less tendency to knock, plus motors with higher compression, in which to burn it efficiently.

High-octane gasoline is no more "explosive" than any other, no more dangerous, has no more thermal units in it. Its octane rating does not give easier starting; that comes from other ingredients.

Tetraethyl lead is still the most effective ingredient for stepping up octane rating. It is added to nearly all automotive and aircraft fuels because, within certain limits, it increases octane rating at less expense than any of the hydrocarbons, or any of the many other ingredients that have been tried. Unfortunately, there is a severe shortage of lead at the moment. Though probably temporary, it may result in lopping off some of the octane numbers that have been added to our motor fuel in recent months. Or we may have to pay somewhat more for gasoline of a given octane number until the shortage has been overcome.

The supermotor capable of using the new superfuels efficiently may be some distance away, but tomorrow's motors still may deliver more power or mileage from a gallon of new gasoline blends. The improvements of 1947 and 1948 are expected to continue a trend that began 10 years before the war.

Compression ratios of stock automobile motors rose from an average 5.3-to-1, in 1931, to 6.7-to-1 in 1942 and 1946 models of standard makes. With few exceptions, the compression ratios in 1946 models are the same as before:

| | | | |
|---|---|---|---|
| Buick 40 and 50 | 6.3 to 1 | Nash 600 | 7.1 |
| Buick 70 | 6.6 | Nash (large) | 6.8 |
| Cadillac | 7.25 | Oldsmobile | 6.5 |
| Chevrolet | 6.5 | Packard 6 | 6.71 |
| Ford | 6.7 | Packard 8 | 6.85 |
| Lincoln | 7.2 | Pontiac | 6.5 |
| Mercury | 6.7 | Studebaker | 6.5 |

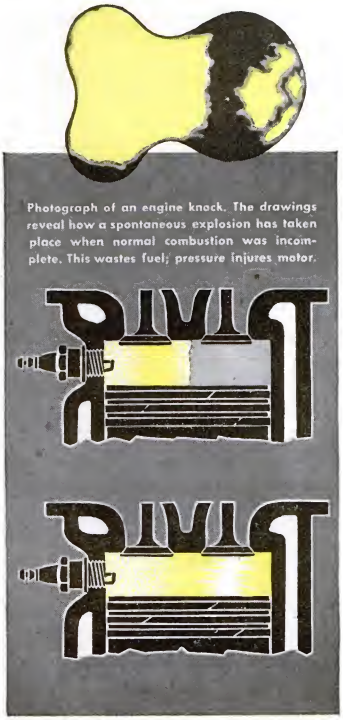
The 1942 compression ratios in a few cars not listed above follow:

| | | | |
|---|---|---|---|
| Chrysler | 6.8 | Plymouth | 6.8 |
| DeSoto | 6.8 | Hudson 6 | 7.25 |
| Dodge | 6.7 | Hudson 8 | 6.50 |

Since 1931 the average octane number of regular-grade gasoline has climbed from 58 to 70. The two lines of steady progress—octane numbers and compression ratios—moved upward in a significantly parallel line across engineers' graphs, shown on page 125. This advance has resulted in greater ton-miles per gallon in the same period.

In designing for the future, all automotive experts know that so far as octane rating is concerned, they can have just about whatever they can use. Individual manufacturers are naturally keeping their own ideas under their hats, but it is reasonable to expect that compression ratios will at first take another normal step upward.

The highest ratio in stock cars now is 7.25 to 1. Engines with ratios of 8 to 1 and up to 9.4 to 1 were used, however, in a recent series of tests conducted by the Ethyl Corporation. New blends of gasoline, never tried in an auto motor before, were furnished for these road tests by 11 large oil companies. The octane numbers or other properties of the fuels were not disclosed, but engineers know that for such compression ratios motors must have gasoline of near 100-octane or they will knock themselves to pieces.



Photograph of an engine knock. The drawings reveal how a spontaneous explosion has taken place when normal combustion was incomplete. This wastes fuel; pressure injures motor.

Even with the required knock-suppressing fuel available, every increase of compression presents new problems. The increased heat and pressure may break piston rings, bearings and crankshafts, so motors must be made more rugged. More efficient cooling must be provided. Higher temperatures are more destructive of lubricating oil, so more heat-resistant oils must be provided. In short, a motor must be completely redesigned before it can stand the extra strains involved in extracting the full power out of a gallon of high-octane fuel.

But despite these problems, the availability of supergasolines is a challenge to automotive designers. If they find it impracticable to boost compression ratios much they may devise new kinds of superchargers, different manifolding, or valves that will enable motors to gulp down bigger charges of fuel-air mixtures.

The goal for auto manufacturers to shoot at now is a motor that can realize the potential power of 100-octane gasoline. When they have that, they will have made a start toward utilizing triptane or possibly other new fuels of still more remarkable performance.

What it is possible to get out of these hydrocarbons under suitable conditions was demonstrated recently at General Motors laboratories. Using triptane with tetraethyl lead added, experimenters produced power four times as great as that of 100-octane gasolines, eight times as great as that of the 60-octane fuel we all were using 10 or 12 years ago.

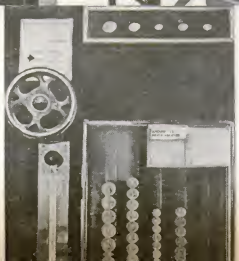
This impressive feat was accomplished under highly special laboratory conditions employing every means of squeezing out the potential power. To duplicate it in a simple and practical engine is quite a different matter, but it may be done.

A New York restaurant has substituted machinery for waiters. The diner needs only to write out the order and drop the card into a slot in the table, as above (see PSM, Apr. '40, p. 126). In a basement kitchen the food is prepared and, course by course, served through the center of the table, which operates like a dumb-waiter (right) by hand or hydraulic power, compressed air, or electricity.

# LIVING AUTOMATICALLY

## New machines ready to serve at the drop of a coin.

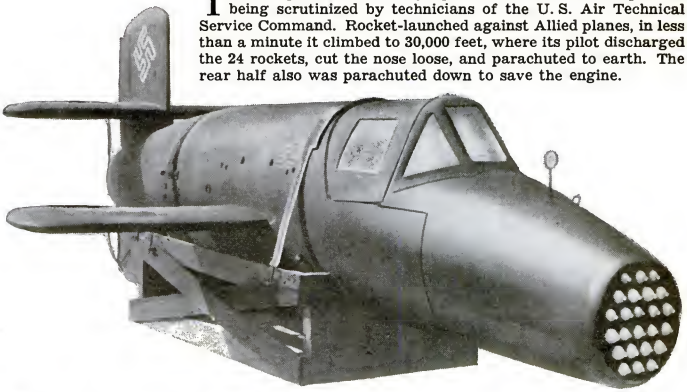
The Transmeter Ticket Vending Machine prints, dates, records and delivers a railroad ticket in a few seconds. The commuter merely sets dial (right) to point of destination and inserts fare. Inventor R. V. Anderson, New York, plans transmeters to sell tickets for theaters and sports events.

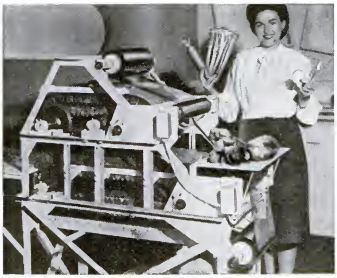


This coin-operated typewriter will be available in hotel lobbies, railroad stations, and even drugstores. When a dime is inserted, the machine unlocks, setting a meter that measures 325 lineal inches—enough to fill a standard letterhead single-spaced and address on envelope or two. Marlyn C. Ford, of Jacksonville, Fla., devised the automatic machine.

## U. S. Experts Study "Viper," Nazi Come-Apart Interceptor

THE "Viper" (below), a jet-powered German interceptor, is being scrutinized by technicians of the U. S. Air Technical Service Command. Rocket-launched against Allied planes, in less than a minute it climbed to 30,000 feet, where its pilot discharged the 24 rockets, cut the nose loose, and parachuted to earth. The rear half also was parachuted down to save the engine.





## Airtight Wrapping of Variety of Goods Is Speeded Up

HIGH-SPEED, moistureproof wrapping of anything from fish to toothbrushes, from vegetables to claw hammers, from cosmetics to small machines is done by the device at the left. It wraps the objects in Pliofilm, a Goodyear product, at rates up to 20 a minute, utilizing electrically heated rollers for warming the film and sponge-rubber belts that cushion it tightly around the surfaces and force all air from within the enclosures. Food or mechanical objects packaged in this manner are safe from decay and rust up to several years.

## Movies For Passengers on Long Plane Hops

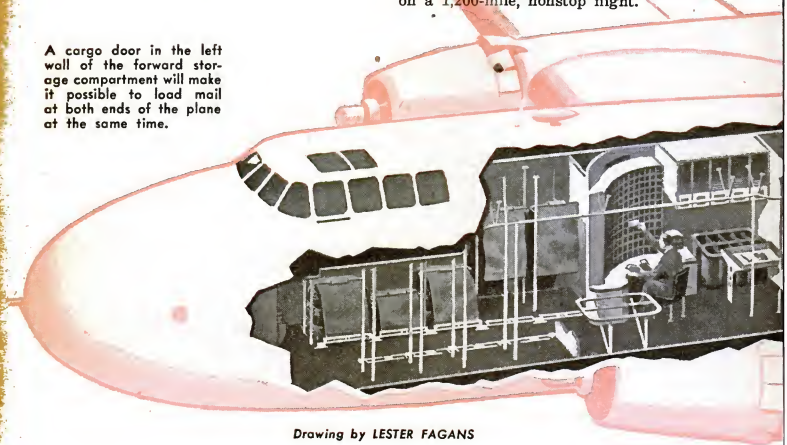
FULL-LENGTH movies, newsreels, or shorts can be shown to airplane passengers by a new self-contained projection unit (right). Developed by the Air Transport Command and Army Signal Corps, the outfit also provides radio broadcasts and recorded music from sound films, a program being heard either through a loudspeaker or individual headsets. Plane movies entertained many of the war wounded who were evacuated over thousands of miles by air.

The Post Office's interest in air parcel post has led to tests of 'chute delivery from mail-carrying DC-3s.

# Tomorrow's

FLEETS of "flying mailcars," peacetime versions of the Fairchild C-82s in which the Army transported tanks, guns, troops and supplies during World War II, may soon speed delivery of U. S. airmail and help to slash its cost. Other recent attempts to improve postal service have included tests of airmail delivery by special parachutes that do not sway. Fairchild engineers have named their huge, two-engined cargo plane the Packet, and have designed light, sturdy equipment for its squared interior to permit mail to be sorted in flight. The Packet will carry seven tons of mail on short hops, six tons on 500-mile, nonstop trips, four tons on a 1,200-mile, nonstop flight.

A cargo door in the left wall of the forward storage compartment will make it possible to load mail at both ends of the plane at the same time.

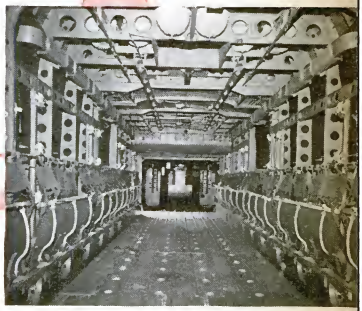


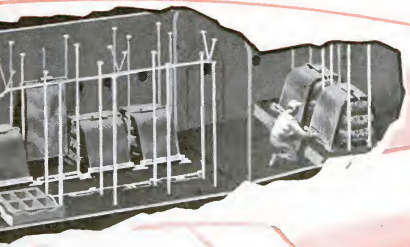
*Drawing by LESTER FAGANS*

A shipment of silver, in the hold of an ordinary mail plane, ready for delivery from the air by wobbleless parachutes.

# MAIL TRAINS

The huge cargo hold (right) of the Packet is 38½ ft. long, 8½ ft. wide, and 8½ ft. high, except under the pilots' cabin.





Double doors in the rear of the big Fairchild cargo plane (below) open at truckbed height, making it easier to load and unload quickly.

The "flying mailcar" is designed to be divided into three sections. In the middle of the plane, clerks will sort mail at a curved letter rack and on tables of lightweight metal and plywood. In bumpy air they can steady themselves with the aid of an overhead rail. Mailbags will be stored in forward and rear compartments, registered letters locked in drawers.

# AMERICAN CAMERAS

## War-Born Skills Take Lead from European Products

By HARTLEY E. HOWE

FOR THE first time in more than four years new cameras are beginning to appear in the market. And almost without exception the best of them are "Made in America." World War II has given an impetus to a trend that began 20 years ago. No longer will photographers look abroad for the finest cameras and lenses. American manufacturers have not only equaled traditionally fine European equipment; in several ways they have surpassed it.

Fundamental to this development has been the achievement of adequate production capacity of the finest optical glass, long almost a European monopoly. At the same time, the recent invention of completely new, rare-element glass has made possible the design of lenses of higher speed and better definition than previously thought possible (PSM, Mar. '46, p. 122).

For the time being, however, the difficulties of reconversion plus consumer demand will delay any dramatic new developments in cameras themselves. Most of the familiar models will be back unchanged except for the addition of built-in flash synchronization and antireflection lens coatings. Emphasis is on reflex cameras, often combined with the increasingly popular 2¼ x 2¼ size. Stereoscopic fans will find more attention being paid to their specialized type of photography.

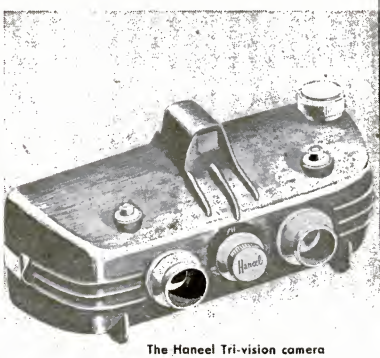
Outstanding among the new reflexes is the new Ansco luxury model, due shortly on the market. It's a twin-lens job, takes a dozen 2¼ x 2¼ negatives on 120 (B2) roll film. The taking lens is a coated f/3.5 Wollensak anastigmat with a focal length of 83 mm., and the cock-and-release-type shutter has speeds ranging from one-half to 1/400 second. The set and release controls are on the sides of the lens panel, and the shutter-speed markings can be read when the camera is in operating position. Other features are an all-metal body, automatic film transport, double-exposure prevention device, and eye-level optical view finder to supplement the ground glass.

Eastman Kodak is also bringing out a small reflex camera in the same 2½-inch square negative size, using 620 roll film. Both viewing and taking lenses are Kodak f/3.5 anastigmats of 80-mm. focal length, and the taking lens is coated to minimize reflection loss. The new Flash Kodamatic Shutter provides shutter speeds ranging from ½ to 1/200 of a second, and can be adjusted for accurate synchronization of all flash bulbs. The focusing, as in all twin-lens reflexes, is done on the ground glass, the viewing lens being geared to the taking lens: focusing range is from 3½ feet to infinity. The camera also has a built-in depth-of-field scale, indicated compensation for focusing while using infra-red film, and die-cast aluminum body.

The Kodak Medalist II will be among the outstanding cameras. It is essentially an improved version of the original Medalist. Differences include an improved film transport system that prevents double exposure and automatically cocks the shutter. The winding knob has been raised to where it is easier to get at and can be more easily gripped. Furthermore, the body shutter release is now operative when the accessory back—used for ground-glass focusing and sheet film—is in place.

Following the current trend, the Medalist II has built-in flash synchronization and a coated lens. To speed up operation, click stops have been added to diaphragm and shutter scales, and the depth-of-field scale, which is combined with the focusing scale, has been redesigned for easier reading.

At least two American companies are now




The Haneel Tri-vision camera takes either six stereo pictures or 12 singles.

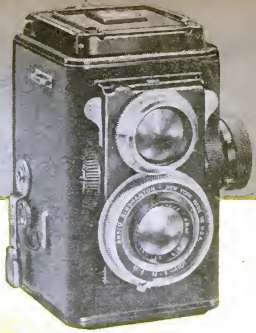
# STEP OUT

taking advantage of the rising interest of amateurs in stereoscopic photography. The Stereo-Realist, built by the David White Co., has two Ilex-Paragon 35-mm. coated lenses, f/3.5, in shutters with speeds from one second to 1/200 of a second, and built-in synchronization. Camera body is all-metal construction with a hinged lens cap to cover the two lenses. Companion viewer has achromatic lenses and self-contained illumination.

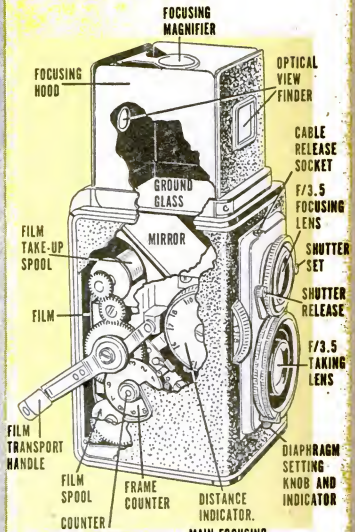
The Haneel Tri-vision Camera and viewer are less expensive. The camera has three diaphragm openings: f/8, f/11, f/16, with a shutter speed of 1/80 of a second. The two lenses are color-corrected and coated to prevent reflection. The camera uses 828 roll film on which it makes six stereo pairs. By capping one lens, 12 single negatives can be made on the same amount of film.

The Fairchild Camera and Instrument Company, specialist in aerial cameras, has also entered the hand-camera field. Although designs are still in the formative stage, the company has decided to begin early manufacture of at least three different types: a reflex, a range-finder type, and a third camera still in design process.

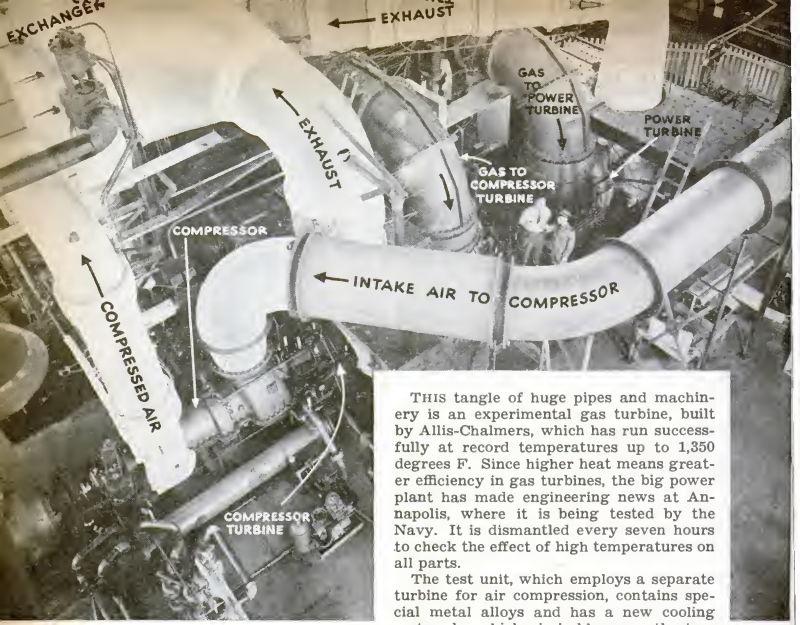
At present the Graflex Corporation is producing only the 4 x 5 Anniversary Speed Graphic and Graphic View cameras, both prewar models; but the Speed Graphics are equipped with coated lenses mounted in shutters with built-in flash synchronization.



New Ansco luxury model reflex, diagramed below with the viewing hood raised for focusing.



Medalist II has refinements over first version, including flash synchronization and a coated lens.




## Experimental Gas Turbine Runs At Record High Temperatures

THIS tangle of huge pipes and machinery is an experimental gas turbine, built by Allis-Chalmers, which has run successfully at record temperatures up to 1,350 degrees F. Since higher heat means greater efficiency in gas turbines, the big power plant has made engineering news at Annapolis, where it is being tested by the Navy. It is dismantled every seven hours to check the effect of high temperatures on all parts.

The test unit, which employs a separate turbine for air compression, contains special metal alloys and has a new cooling system by which air is blown on the turbine blades at points where heat might damage the metal. Pipes shown above handle 40,000 cubic feet of air per minute.

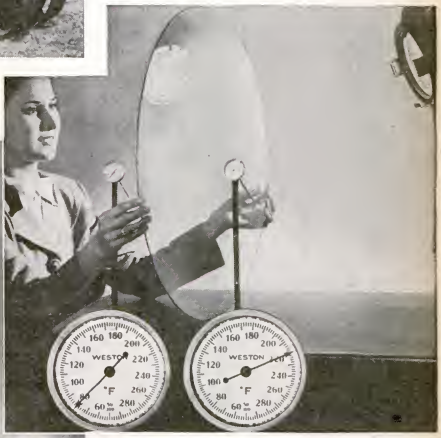
## Bullets Now Tested By Electronics

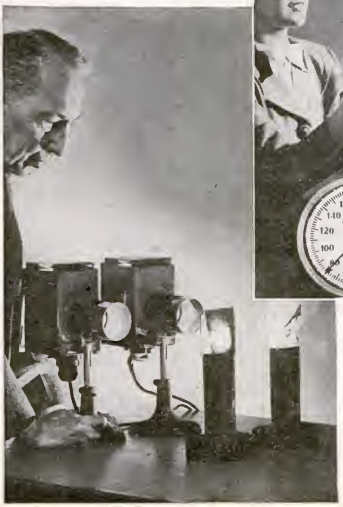
BOTH the accuracy and velocity of ammunition can be tested at one time by an electronic device, which counts in 100,000ths of a second. The "counter chronograph" starts counting as a bullet whines over one photoelectric cell, stops counting when it passes a second cell at a specified distance. Neon bulbs (left) light the cells.

*march of* SCIENCE

## Australian Device Makes Maps Of the Ground It Covers

THE odd apparatus at left is the Australian "co-graph," which automatically maps the ground over which it moves. Named for its inventor, Lt. Col. H. J. F. Coe, the machine can be operated by a pedestrian or set up in a trailer (PSM, Dec. '44, p. 134). The co-graph obtains direction by being oriented with a sensitive compass; gets distance from a calibrated ground wheel. Drive from the wheel turns a paper-carrying roller under a fixed pencil, and thus a course is plotted to scale. The co-graph's upper part —sighting tube, compass, mirror, and map-making equipment—weighs only 10 pounds and is strapped to the user's body.



## New Glass Absorbs Most Heat Yet Transmits True Colors

A NEW glass, made by American Optical Co., absorbs nine-tenths of the heat from a projector and yet transmits color accurately. Spotlight at right above has heated the near side of a circle of this glass to 220 degrees F., while temperature behind stays at 80. Left, film on right-hand pedestal burns while glass protected film nearer light is unharmed.

# HOME OWNERS

**SCALE MODELS OF THE HOME** you are planning can be made right on your dining-room table with the aid of a kit now on the market. Included are grooved footing strips, cutout wall sections with doors and windows, a scaled base sheet on which to arrange them, and cutouts of typical furniture—such as the grand piano in the hand of the girl above—so you can tell whether the rooms you visualize will take the furniture you own.

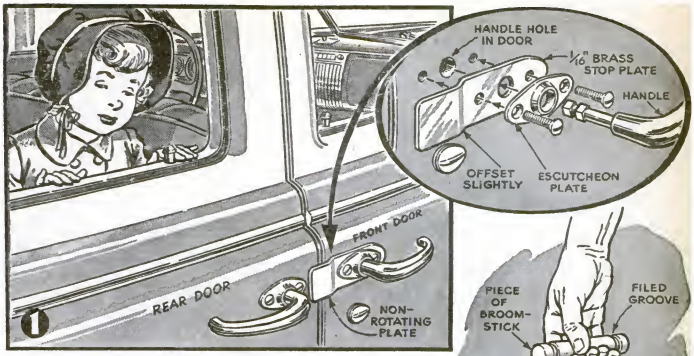
Unlike drawings and conventional floor plans, a model requires no special training to construct, and changes are of course possible without erasure. The Plan-A-Home Model Company, of Elkhart, Ind., makes the kit.

**AIR FLOW** through forced warm-air heating systems is registered on the dial of the indicator shown below. The device is inserted in a ½" by 2½" slot cut in the main duct and mounted with self-tapping sheet-metal screws. It is adjusted to read 100-percent flow with clean air filters and the system functioning properly. Lesser readings will then indicate mechanical or other trouble, or that cleaning is again in order. The Dollinger Corporation, of Rochester, N. Y., is the manufacturer.

**NO-ROACH FLOORING,** a copper-powder and magnesium oxychloride cement called Hubbellite, has been developed by Dean S. Hubbell, of the Mellon Institute of Industrial Research, Pittsburgh. It is a repellent covering that can be applied 3/16" to ¼" thick on any floor surface, including ordinary wood.

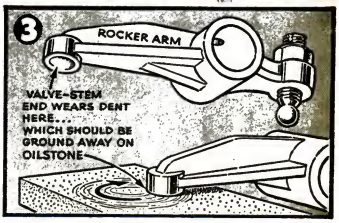
**GLASS BLOCKS** in panels are the suggestion of the month for modernizing and brightening an old bathroom. These translucent blocks, 3⅞" thick and 6", 8", or 12" square, may be used in an opening broken through an interior wall (such as over the bathtub), in a present window (with a ventilating pane included), or in both. In an interior wall, they bring light to or from an adjacent room. Insulux blocks are made by Owens-Illinois Glass.

# USEFUL AUTO HINTS



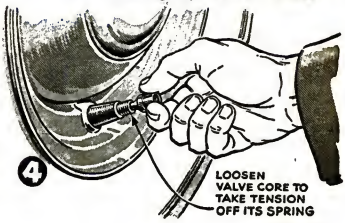

**1 A REAR-DOOR STOP** ends the danger of children accidentally opening the rear door and falling out. When the front door is closed, the rear door cannot be opened; the front door must be opened first before the rear door is freed. Notice that the stop plate doesn't turn with the handle, but is just clamped fast.—D. H. BERGMAN

**2 LIFTING A BATTERY** out of a car is an awkward job without a battery carrier. However, it's not hard to build a carrier from two washers, some heavy wire, and a piece of broomstick. The two washers should be large enough to fit over the battery posts, and small enough to give a purchase on the posts when lifted from the side. Instead of a broomstick, a sturdy hardwood dowel can be used.—E. L. RUSSELL



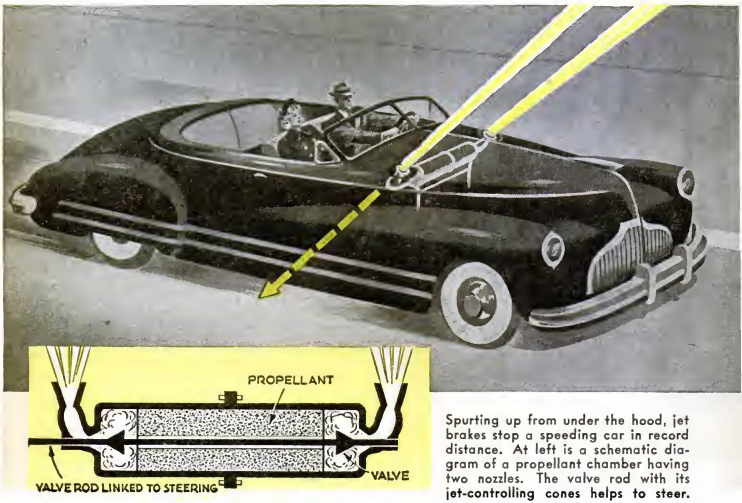

**3 VALVE NOISES** sometimes persist in overhead valve engines despite careful adjustment. The trouble is often in the rocker arms. During thousands of miles of operation, the beating of the rocker arm on the valve stem sometimes wears a depression in the rocker-arm face. Then the feeler gauge bridges the depression and gives a false clearance reading when the valve is adjusted. To remove the noise, remove the rocker arm and grind down the face carefully until it is flat.—A. H. WAYCHOFF

Drawings by STEWART ROUSE




**4 PUMPING UP A FLAT** tire takes less back-bending if the valve core is loosened a couple of turns. When the pumping is finished, the core can be tightened again with little loss of air.—W. N. LAWRIE

# Rocket Brakes for Emergency Stops?




Spurting up from under the hood, jet brakes stop a speeding car in record distance. At left is a schematic diagram of a propellant chamber having two nozzles. The valve rod with its jet-controlling cones helps to steer.

## POWERFUL JETS CAN STOP CAR IN HALF NORMAL BRAKING DISTANCE

**By Capt. G. C. MacDonald**

ROCKET propellants, cased in special jet housings under the hood, may be used on future passenger cars and trucks as spectacularly efficient emergency brakes.

What is believed to be the first vehicle using jet emergency brakes has already been tested at the Allegany Ballistics Laboratory, Cumberland, Md., with the writer serving as test driver. An ordinary jeep, provided with a safety belt and a steel pyramid for protection in case of upset, was fitted with two jet thrust units mounted beside the hood at an angle of 45 deg. Segments of the wheels were painted white to permit high-speed camera analysis of wheel behavior during stopping.

In a series of test runs, the jeep decelerated at twice gravity, or 64 feet per second. This is a rather severe stop, and a design for passenger-car use should employ somewhat less thrust. Braking comparisons are charted schematically on the facing page; cars *A, B,* and *C* are assumed to be traveling at 60 m.p.h., and are braked hard at the black line at the left. Car *A,* with ordinary brakes in excellent condition, requiring 160 feet to stop; car *B,* which has a jet-thrust brake, stops in 80 feet; and car *C,* included for comparison, shows the performance of the test jeep.

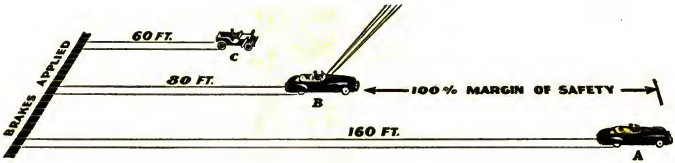
Even more dramatic results are achieved when jet brakes are compared with ordinary brakes under slippery driving conditions. Calculations indicate that on an icy highway a jet-equipped car could stop in a fifth of the distance required by present cars. It should be noted that the angle at which the thrust nozzles are placed not only produces a backward thrust, but it also presses the wheels harder on the ground and thus increases the effectiveness of the wheel brakes.

As developed under the leadership of Dr. R. E. Gibson, director of research at the Laboratory, the rocket-brake project was not intended to find a substitute for conventional brakes. Instead, the purpose was to study the possibility of augmenting standard

brakes in emergency situations, and to provide protection on icy surfaces and in the event of brake failure. Replacement of the propellant, which is entirely consumed in one application, may cost between $10 and $25; but it should be pointed out that even a minor collision involving a smashed-in radiator grille and front fender can very readily involve far greater expense, even assuming no one is injured. Considering the consequences of a mountainside runaway of a trailer truck, caused perhaps by a ruptured air line, the cost of even the large propellant charge necessary is a bargain in disaster insurance.

The installation used in these tests was much bulkier than what is contemplated for possible commercial use. A single propellant chamber, mounted crosswise at the rear of the engine compartment, is a more likely design. The jets would pass through the hood via a pair of "blow-out plates." A sliding valve rod, linked to the steering gear, would provide a means of steering the car during the stop. If for instance the wheels are swung to the right, the rod would move to the left, cutting down the left jet. This feature is especially desirable since locked front wheels won't steer effectively, a fact that now contributes to many accidents on icy roads and when curves are entered at excessive speed. Electrical firing of the rockets would probably be used, triggered by extreme pressure or extreme travel of the brake pedal.

Certain disadvantages must be recognized. The propellant offers an additional hazard in case of an automobile fire. However, a fusible plug melting at a low temperature would protect the chamber from bursting, though it would not prevent the propellant from burning with about the same effect as several gallons of gasoline. In the event of a collision that both upset the car and fired the rockets, a zone of 10 feet or so in front of each nozzle would be dangerous, due to the high temperature and velocity of the jet gases. If the car remained upright, the jets would blow off harmlessly. Accidental firing of the rockets when the car is either motionless or moving slowly might be risky. This could be eliminated with a centrifugal switch that would only cut in the firing circuit at a predetermined minimum speed.




Above, a comparison of an ordinary car at 60 m.p.h. with one having jet brakes and with the test jeep.

Below, the writer makes a trial stop. The pyramid is to give protection in case the jeep turns over.

# *six pointers on* SUMMERIZING YOUR CAR

## WATCH THESE FOCAL POINTS TO LICK WARM-WEATHER TROUBLES

**1 TIRES.** In summertime tires will get hot. Watching tire pressures may keep them a little cooler. Low pressure causes the tire casing to flex more violently than normal pressure. Violent flexing builds up heat in the tire and may cause a breakdown in the tire sidewall. Another way to keep tires cooler is to resist the temptation to bleed them when they're hot and show a higher pressure than the tire is supposed to carry. Bleeding will reduce the pressure, but will increase the temperature. Check pressures when the tire is cool—early morning, or late evening.

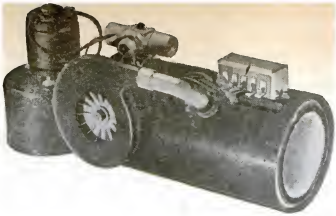
**2 ENGINE.** Grease and oil on the outside of the engine block will raise the engine temperature. The block plays a part in the cooling system by carrying out the heat from the water jacket to the air being blown over the engine. Grease and oil on the engine pick up dust and form a blanket of insulation around the engine. This insulation keeps the heat inside and doesn't let the metal dissipate it to the air. Overheating may score and burn engine parts.

**3 AIR CLEANERS.** Dust that gets inside the engine can wear down close-fitting parts as effectively as an emery wheel. Air cleaners are built to scrub the air clear of dust before the air gets inside. The cleaners work best when they're clean. A dirty filter lets dirty air into the engine. Dunk the element in gas or solvent and blow dry with compressed air. (Manufacturers advise going easy with the air pressure—too much can pack the filter element and ruin it.) In oil-bath cleaners, try to keep the oil at the specified level. Change oil that feels gritty.

**4 BATTERIES** get thirstier in summer. This doesn't mean the water level should be raised, but that the water must be added more often. Proper level is still ¼" to ⅜" above the separators—winter or summer. Too much water can cause the battery to overflow when it charges. Spilled electrolyte corrodes the battery carrier, cables, and terminals. Keep the vent plugs tightened down. On some batteries if the plug is loose, the valve in the filler hole will jiggle up and down and pump electrolyte out of the battery. Vents should be kept open so the battery can breathe.

**5 COOLING SYSTEM.** Most drivers have finished spring cooling-system cleaning, drained the antifreeze, and flushed the system. In some areas rust inhibitor was scarce. It is still not too late to add inhibitor. Rust forms more quickly during high-speed summer driving than during winter driving. A clean radiator core is also part of engine cooling. Leaves, bugs, and bent fins all cut down the radiator area, and retard efficient cooling.

**6 SPECIAL ADJUSTMENTS.** Some cars have manual adjustments to be made for summer driving. On Fords, and some other cars, the carburetor has a summer position. The accelerating-pump rod should be moved to hole No. 1. Other cars have a manifold heat-control valve to be adjusted for summer driving. The control has an "off" or "summer" position marked on the side of the manifold. In the automatic-type manifold heat controls, check the spring to see if the valve is operating. A broken spring causes an engine ping.



# AUTO IDEAS

**AUTOMOBILE HEATERS** haven't been in the "new ideas" category for many years. The "South Wind" Heater (above), made by Stewart-Warner Corp., is new. It's mounted under the hood, and has an air intake near the radiator. The heater burns gasoline to warm the air, which is sent back through ducts to outlets at the windshield and under the front seat.

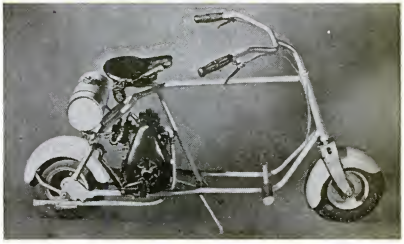
FIGHTING A FIRE

FILLING A TIRE

**1946 ROTZELL SEDAN** is the answer by Edward P. Rotzell, Philadelphia mechanic, to the shortage of new cars. He built this low-slung job from parts of half-a-dozen makes. Here he's off through what once was the window of his shop, to road-test his car.

**"BOTTLED POWER"** in a small cylinder has been marketed to help drivers in two automobile emergencies—fires and flat tires. The "power" is carbon dioxide, well known as an effective gas for putting out fires, but new as a gas for filling tires. A small hose connects the cylinder to the tire valve. According to Beacon Devices, manufacturer of the gadget, the gas actually prolongs tire life by preventing oxidation of the rubber. The gas is odorless and will not stain clothes.

**MOTOR SCOOTERS** are getting lighter and cheaper to run. The "Scootercycle" made by Mead Cycle Co., Chicago, uses aircraft tubing for the frame, and ready to ride weighs only 83 lb. Future plans are to reduce the weight to 50 lb. It is said to run 100 miles on a gallon of gas. The engine is 1½ hp. and develops 35 m.p.h. Levers under the handle bars operate gas and brake pedals. The clutch is automatic, leaving the feet free. A wire delivery basket can be mounted over the front wheel.



# GUS goes to the races

**By MARTIN BUNN**

TOWARD four on a warm Friday afternoon Gus Wilson looked out his shop window at a pelting rain. "This is going to keep up all night," he predicted to Stan Hicks, the Model Garage grease monkey. "There'll be wet grounds and no ball game tomorrow."

Just about that time, out at the old Lakeview half-mile track eight miles away, Jack Dunn came into the tack room of a stable. It was here he kept his string of half a dozen selling platers and one good stake horse with a bad leg.

A little old Negro looked up expectantly from a bit he was polishing. "No good, Henny," Dunn told him. "We came in fifth —seven lengths back of the money."

Henny shook his head. "That oats fellah was roun', Mistah Jack," he said.

Dunn grunted, walked to the window, and watched the pouring rain. "We've got to win a good purse soon, or we're done for," he muttered. "Looks like it'll rain hard all night, and that's what the weather man says. If it does, the footing at Empire Park's going to be fetlock deep, and Air Hero ought to be able to do it."

Henny nodded. "Ah was jes' thinkin' that, Mistah Jack," he agreed.

Dunn swung around, went to the deal table that served him as desk, found the Empire Park condition book, and thumbed through its pages. "Here we are . . . . 'Brookdale Handicap—$3,000 added—mile and a sixteenth.' Demerara's the horse to beat, and Air Hero can do it. I wouldn't risk that tendon on a hard track for another two weeks, but in mud . . . How's that Army truck?"

"Runnin' fine, Mistah Jack," Henny said.

"Post time for the Brookdale is 4:30," Dunn told him. "Keep Air Hero quiet in his stall as long as you can, but start in time. Don't make it too early, or he'll fuss himself into a lather with waiting, but don't be a minute later than 4:15."

And just about then at Empire Park, 10 miles the other side of our town, two sharp-faced characters were conferring under the grandstand. "I tell you, Brownie, he's a real mudder, and with the track soft Dunn will start him," one insisted.

Brownie swore. "Best chance of the season for a cleanup gone. With Air Hero out, Demerara would be sure. And I ain't betting heavy dough if it ain't sure, Al."

"Yeah," Al blinked. "How much is it worth for Air Hero to show up too late?"

Brownie looked at him hard. "It's worth two hundred," he said. "But no rough stuff —the Pinks are watching me."

"There's no rough stuff to a truck stalling," Al answered. "I used to be a mechanic—and a good one—in the old days."

SATURDAY was sunny, so Gus hopefully phoned the ball park, but the game had been called because of wet grounds. Joe Clark, his partner in the Model Garage, was sympathetic. "Why don't you go to Empire Park?" he urged. "Do you good to get outdoors."

"Not me," Gus laughed. "One-horsepower nags are too slow for me. I've seen all the top race drivers since Barney Oldfield pour out real speed."

Joe went back into the office and Gus set about tuning the 2½-ton 6 x 6 truck Chris Blauvelt had bought from military surplus. He was still at it when he was interrupted by a breathless voice saying: "Excuse me, mistah! Excuse me, mistah!"

He looked up at a little Negro whose face glistened with muddy sweat and who gasped from near exhaustion.

"Take it easy," Gus warned, and pushed the little man into a chair. "Feel better now?" he asked after the old man had had a cup of water. "Who are you?"

"Ah's Henny Gilpin, mistah. No one knows me no mo', but Ah was a right good

As they pulled up, a sleek chestnut stuck his head over the truck side.

jockey when I rode for old Mistah Jack Dunn."

"O. K., Henny," Gus said. "Now tell me what's the matter."

"It's mah truck, mistah. She stalled, and I run a long ways befo' a gen'man gave me a lift. He 'lowed maybe yo' all could get it started."

"Sure, I'll get it started for you," Gus assured him. "But what was the idea of half-killing yourself with running?"

"Ah got Air Hero in it," Henny moaned.

"Who's he?" Gus asked, puzzled.

Henny pulled himself together. "Ah works for young Mistah Jack Dunn—the Big Pine Stable," he explained. "Our stake hoss, Air Hero, is entered in the Brookdale Han'icap at Empiah Park, an' Mistah Jack's dependin' on me to get there by 4:15."

"Oh, I see," Gus said. "But you can't be blamed if your truck stalled."

"Mistah, yo' gotta un'erstan'," Henny urged desperately. "Unless Air Hero win, Mistah Jack's gonna be sold out." He looked at the shop clock. "Deah Lawd," he murmured. "It's mos' quarter to foah."

Gus was tossing tools into his roadster. "What kind of truck is it?" he asked.

"She's an old Army truck—jes' like the one yo' is working on," Henny said.

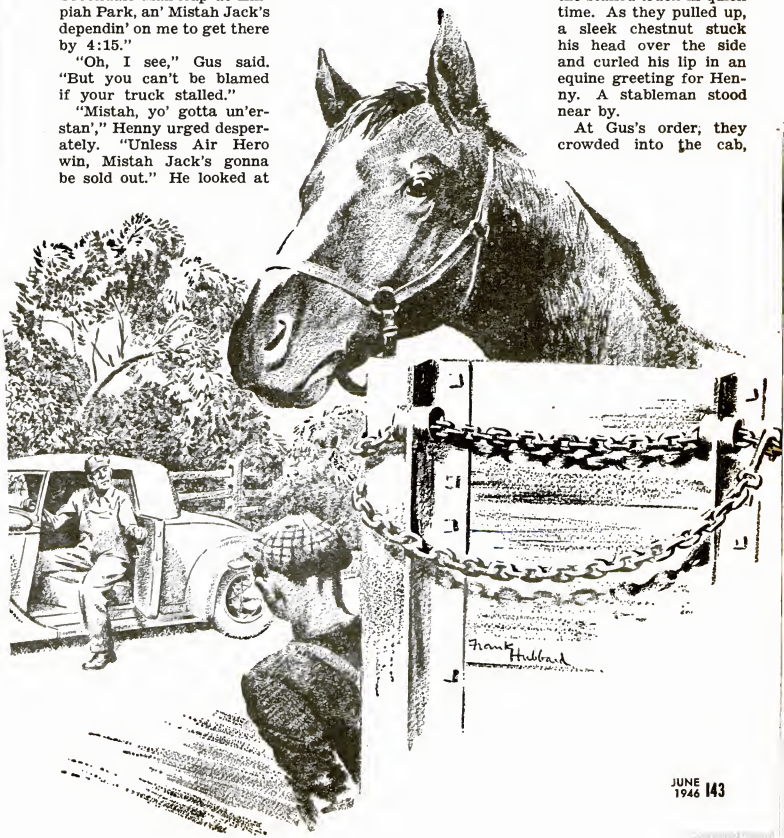
Something Blauvelt's driver had told him clicked in Gus's mind. "What happened before it stalled?" he demanded.

"She jes' gasped a time or two."

"That *could* be it," Gus muttered. He bent over the truck engine for a moment, and when he straightened up he slipped something into his coverall pocket. Then he jumped into the roadster. "Come on."

Gus took a couple of short cuts and covered the three miles to the stalled truck in quick time. As they pulled up, a sleek chestnut stuck his head over the side and curled his lip in an equine greeting for Henny. A stableman stood near by.

At Gus's order, they crowded into the cab,



Gus at the wheel. They went off smoothly.

"It won't run far," Gus said, "but I'll fix it when it stops." He got up to 40, bypassed town, and the engine died.

Gus jumped out, lifted the hood, examined the oil-bath air cleaner on the crankcase oil-filler pipe, and shouted: "I *did* guess right!" He pulled the filter element he had taken from the Blauvelt truck out of his pocket and fitted it into the air cleaner. A car came up from behind, slowed down as its thin-faced driver stared at them, and speeded up again. Henny wrung his hands. "Please, *do* somethin'."

"I've *done* it," Gus yelled, and they started.

It was exactly 4:15 when they pulled up at the paddock gate. A man ran over to them. "The truck stalled, Mistah Jack," Henny told him as he lowered the ramp, "an' this gen'man fixed it."

Jack Dunn's quick eyes looked Gus over as a bugle blared. "Just in time—there's the saddling call." He led the horse down the ramp. "You've done me a good turn, Mister. How much do I owe you?"

Gus rubbed his chin and looked around the Park. "Oh, a couple of bucks and a ride back to my car would square us," he said.

"Two bucks sounds mighty modest to me, Mister," said Dunn. "I'll do better than that —I'll see that ten bucks goes on Air Hero for you. Okay?"

Gus assented with a laugh. Dunn unpinned his badge and tossed it over. "This'll get you inside," he called as he walked off.

The betting concourse was crowded, and Gus found himself near two men talking earnestly as they waited in the $50 line. "I tell you, Brownie," said one of them, "I fixed that truck good. That cluck Henny wouldn't never have started it if he hadn't got that—" He broke off to stare at Gus.

By then the two men were at the betting window. A buzzer droned and the slide was slammed down just as Brownie tried to shove a sheaf of bills inside. "Ten on Air Hero, ten on Air Hero," he shouted.

"Scram," he was told. "Window's closed."

Brownie cursed, and Gus followed him through the crowd. As they reached the paved "lawn" in front of the grandstand, there was a roar: "They're off!"

A black horse got out in front. "Demerara! Demerara!" roared the huge crowd.

Gus recognized the chestnut in the bunched horses chasing Demerara. They rounded the first turn, and on the backstretch a big gray began cutting Demerara's lead—and with the gray went Air Hero. At the last turn, the gray was gaining on Demerara, and Air Hero's head was even with the gray's shoulder. As they swung into the homestretch, there was a hush. The gray had caught Demerara, but Air Hero had moved faster and was even. Down the stretch he fought it out with the gray, then shot away to win by a length.

Brownie strode up to Gus, shaking with rage. "You asked for this!" he shouted, and swung hard. Gus sidestepped and sent a sharp left hook to his unshaven jaw. Brownie was picking himself up groggily when a track policeman collared him.

"Nice left, Mac," the cop told Gus. "We've been hoping he'd start something."

SOME of us Model Garage regulars dropped in at the shop that evening, and Gus told us his experiences at the races.

"How did you know what was wrong before you saw the truck?" Doc Marvin asked.

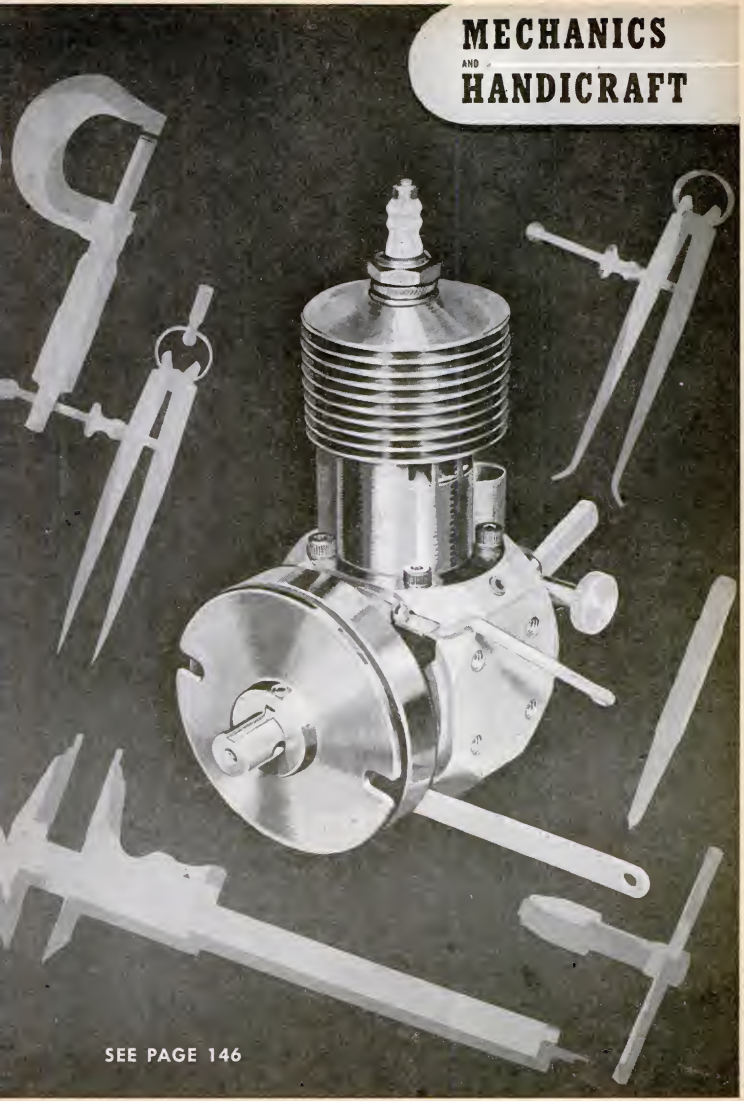
"That model Army truck has a peculiar air cleaner that's part of the crankcase ventilating system," Gus explained. "If the filter element is removed from the air cleaner, the crankcase breather is sealed up. With no air getting into the crankcase, and the air in it being taken out by the ventilating system, a partial vacuum develops in the crankcase. Finally it gets strong enough to hold down the fuel-pump diaphragm. Then no fuel flows into the carburetor, and the engine dies. Air seeps back into the crankcase, and after a while you can start again, but the same thing happens, and the engine dies again. Blauvelt's driver almost lost his stripes in the Army for it once."

Gus pulled a roll of bills from his pocket and carefully divided it in two.

"Here are the winnings from the bet Dunn placed for us. It was Model Garage funds, so Joe and I'll split. There's just one thing I wonder about."

"What's that?" asked Joe.

"What you would have said," Gus grinned, "if the nag hadn't won."




SEE PAGE 146

# *tiny* SUPER

**No castings are needed for this speedy ball-bearing gas engine. Reliable and easy to start, it will power a model plane, car, or boat in flashy style.**

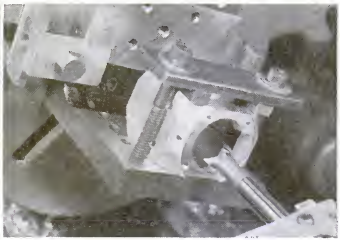
By J. C. MAGEE

PART I

**HIGH-SPEED GASOLINE ENGINE**

| | | | |
|---|---|---|---|
| BORE | 1" | R.P.M. | 13,000 |
| STROKE | 1" | WEIGHT (less flywheel) | 15 oz. |
| DISPLACEMENT | 12.7 cc. | HP. | ¼ |
| OVERALL HEIGHT | 4⅛" | COMPRESSION RATIO | 15 to 1 |

An angle plate mounted on the faceplate holds the crankcase. The indicator checks for squareness.



Then the crankcase is bolted to the angle plate, and the fit for the cylinder is carefully bored.

Two views of the crankcase with the machining completed. At left, the crankcase from the front at the angle shown in the assembly at top.

And at right, a view of the crankcase from the rear. The groove that can be seen inside the bore can be cut with a homemade tool.

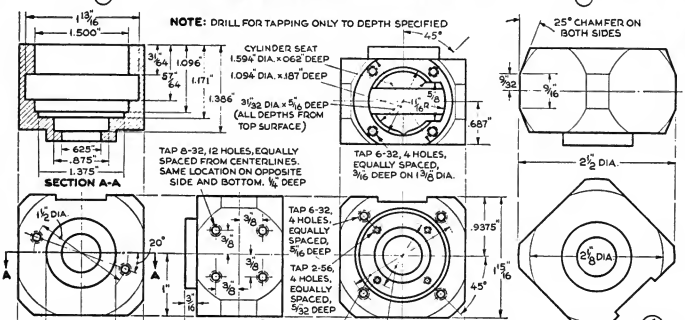
# ENGINE *hits 13,000 r.p.m.*

THIS is just the model gas engine you have been waiting for. And after you've built it, you *can*, if you wish, put it up on the mantelpiece for all to admire. But you won't do that, for it will rev up to 13,000 without a murmur and supply plenty of power and speed for a model car or model boat. With a propeller adapter, it can be used as a power plant for an iceboat or a large model airplane. It requires no castings, is sturdily designed, and starts easily, but remember that performance can only be proportional to the care and workmanship you put into its construction.

The solid crankshaft is mounted on two ball bearings, one on either side of the crankpin, an arrangement that provides perfect support for the crankshaft while it travels at high speed. A rotary valve is an integral part of the crankshaft. This allows a greater charge of gas mixture to be drawn into the crankcase at each revolution than the cylinder port common in two-cycle engines, so the engine will develop more speed and power. The connecting rod is solid phosphor bronze with a separate bearing cap at the big end to provide for adjustment in case of wear.

Three work sheets are given on this and the following pages. They contain a de-

## WORK SHEET NUMBER ONE




### PART 1, CRANKCASE

1. Rough-turn, allowing 1/32" stock on all surfaces. Do not drill or bore the cylinder hole.

2. Allow the piece to stand for a few days to equalize strains.

3. Chuck lightly in the four-jaw chuck, finish-bore inside the crankcase complete, using the grooving tool shown on page 148, and face the end. Fit the ball bearing (part 10) to a push fit in the .875" diameter bore. The depth of the bearing bore should be .003" less than the width of the ball bearing. Boring and facing must be carefully done in one setting (chucking) to obtain perfect concentricity of all fits.

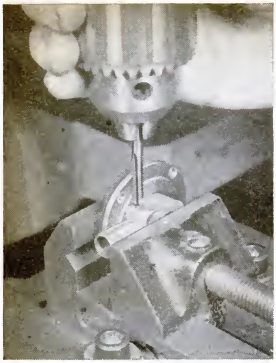
4. Chuck and turn the arbor on page 151 to a push fit in the 1.500" diameter of the crankcase. Mount the crankcase on the arbor and face to 1 9/16" over-all length. Assemble with a bolt and washer to prevent slipping. Turn the 1.125" diameter shoulder. Turn the outside diameter of the crankcase and two chamfers.

5. Lay out the cylinder hole. Mount the crankcase dead square on the angle plate in its proper location. Bore and face the cylinder hole complete and face to 1 15/16" over-all length.

6. Lay out, drill, and file the by-pass slot adjacent to the cylinder hole.

7. Lay out, drill, and tap all holes except the four 2-56 holes. Tap the two holes on the boss side 6-32, 5/32" deep.

8. Assemble the completed retainer (part 6) and mark the retainer and crankcase so they will always be assembled in the same position. Spot-drill the four 2-56 holes lightly with a No. 43 drill, remove the retainer, drill and tap the 2-56 holes.



Here is the setup for boring the .502" diameter in the cover held in a nest. Stub arbors and nests assure concentricity of fits when machining can't be done in one chucking.

Tapping of the needle-valve hole in the crankcase cover is best done by hand in the drill press, as above. Just at the right, a rear view of the cover showing the ball bearing, and at the far right, a front view of the completed cover.

tailed, step-by-step explanation of the operations required for making the crankcase assembly. Don't be floored by the fact that some of the dimensions are given to three decimal places. Unlike the work done in a large shop where one mechanic makes only one part, you will be making the entire engine and will have some leeway. What you really want is to be sure that mating parts fit each other without play.

Thus when a crankcase bore of 1.500" is called for and a 1.499" diameter is specified for the crankcase cover, the important thing is to keep within the .001" allowance. If you should make the bore 1.501" by mistake, a 1.500" diameter for the cover will correct the error, and the engine will run as perfectly. Generally, the machinist finds it easier to bore to size first and then turn down the mating piece to fit the bore.

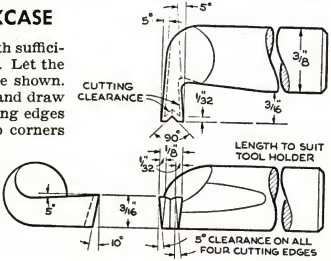
Rough-turning provides an opportunity for you to become acquainted with the part to be machined and the tools that have been ground for the job. Since 1/32" stock is left on for the finish cut, all bores will, of course, be 1/16" undersize and all outside diameters 1/16" oversize.

In roughing out the crankcase, face down both ends first to 1⅝", thereby leaving 1/32" on each end for finish turning. A ½"

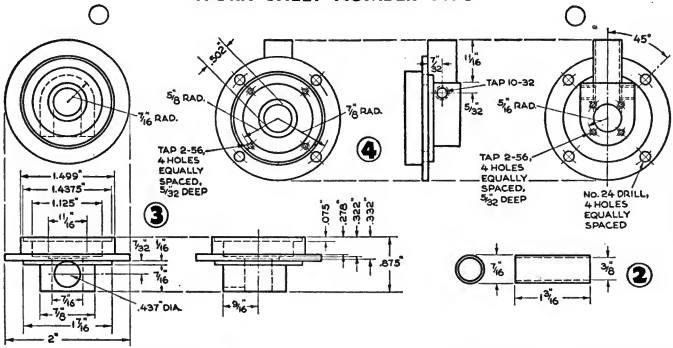
## TOOL FOR GROOVING CRANKCASE

FORGE the gooseneck on ⅜" drill rod with sufficient stock on the end for the cutting edges. Let the tool cool slowly, and then file to the shape shown. Reheat to a cherry red, quench in water, and draw to a light straw color. Touch up the cutting edges on a grinding wheel and round the sharp corners slightly with a fine hand stone.

The tool is fed into the work gradually as the carriage is run back and forth slowly between stops. Its fishtail cutting edges prevent chatter, permit feeding in freely while the work is being traversed, and produce a fine finish.



## WORK SHEET NUMBER TWO




### PART 2, INTAKE TUBE

1. Face to 1 3/16″ long and remove burrs.

### PART 3, CRANKCASE COVER

1. Rough-turn, leaving 1/32″ on surfaces.

2. Let stand a few days to equalize strains.

3. Chuck on the back end, finish-bore inside, turn and face the 1.499″ diameter and shoulder. Fit the ball bearing (part 11) to a push fit in the 1.125″ diameter bore. The depth of the bearing bore should be .003″ less than the width of the ball bearing. Be sure the 1.125″, 1.437″, and 1.499″ fits and shoulders are concentric and square with each other.

4. Chuck lightly on the 1.499″ diameter, finish-turn the outside, and face to length.

5. Mill or file the intake and needle-valve boss and remove burrs.

6. Lay out, drill, and ream the intake-tube hole to a press fit (.0005″ interference) with the intake tube (part 2).

### PART 4, CRANKCASE-COVER ASSEMBLY

1. Oil parts 2 and 3 lightly and assemble.

2. To facilitate boring, file out the portion of the intake tube that extends into the hole.

3. Chuck and bore the nest, shown in the drawing on page 151, to fit the 1.499″ diameter. Mount the cover in the nest and bore the .502″ diameter concentric with fits on the opposite side.

4. Lay out, drill, and tap all holes except the four 2-56 holes around the 1.125″ diameter bearing bore. This operation is the same as in part 1, step 8, using the part 5 retainer. The 10-32 tapped hole for the needle valve is drilled and tapped straight through from one side so the holes will be in alignment.

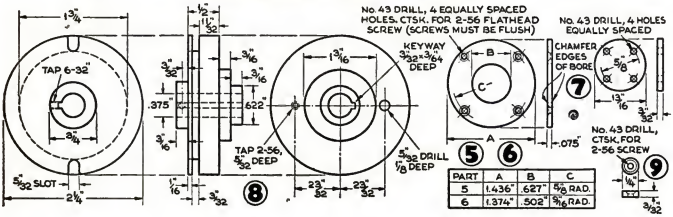
diameter hole is then drilled straight through while the piece is still chucked. More stock can be removed by drilling if a 1″ or 1¼″ drill is available, but be careful not to drill too deep. Next, bore the 1.500″ diameter hole to 1 7/16″ by 1 3/32″ deep, the 1.375″ bore to 1 5/16″ by 1 11/64″ deep, the .875″ bore to 13/16″ by 1 25/64″ deep, and the .625″ bore to 9/16″. The 1/32″ left on the face from which you work automatically leaves 1/32″ at the bottom of each bore for finish-boring.

Some care will be required in making the 1 13/16″ diameter groove, or it may end up in the wrong place. Work from the same face, which is already 1/32″ oversize, and add 1/16″ to the 31/64″ dimension, thus locating the near edge of the groove 35/64″ from the working face and the far side 57/64″. If this sounds involved, study it out with pencil and paper.

Use the grooving tool shown in one of the drawings with a spacer block the width of the groove minus the width of the tool (11/32″—⅛″) or 7/32″. Place the spacer between the lathe stop and the carriage and put another stop against the right-hand end of the carriage. This will restrict the carriage to the proper travel for the width of the groove. A piece of brass carefully clamped to the lathe bed will serve for the right-hand stop. You can use a scale for the measurements, but spacers are more reliable and are as easy to use as a scale.

The crankcase is next turned end for end in the chuck and trued up, and its 1.125″ diameter is then turned to 1 3/16″ by 3/16″ deep. Because of the 1/32″ extra stock on

## WORK SHEET NUMBER THREE




| PART | A | B | C |
|---|---|---|---|
| 5 | 1.436" | .627" | 5/8 RAD. |
| 6 | 1.374" | .502" | 9/16 RAD. |

### PART 5, RETAINER

1. Clamp the duralumin sheet on the faceplate, drill and bore the hole to size.

2. Face to correct thickness and chamfer.

3. Part the piece out 1/32" oversize.

4. Mount on a stub arbor and turn the outside diameter to size and concentric with the bore.

5. Lay out, drill, and countersink.

6. Remove all burrs and sharp edges.

### PART 6, RETAINER

1. Follow the same procedure as in part 5. Be sure to make this part last so the stub arbor can be rechucked and turned down each time.

### PART 7, COVER

1. Clamp the duralumin sheet on the faceplate, take a light facing cut, and part out to size.

2. Lay out, drill, and remove all burrs.

### PART 8, FLYWHEEL

1. Chuck the piece in the lathe, allowing 5/8" of the stock to extend beyond the jaws. Rough-turn the outside diameter, part in the starting-cord groove, finish-face, turn the shoulder, and bore to size.

2. Rechuck and rough out the opposite end complete, allowing 1/32" for finish turning.

3. Turn and polish a stub arbor to fit the bore snugly and mount the flywheel on the arbor.

4. Finish-turn complete, including the outside diameter, and polish. All surfaces must run true.

5. Cut a keyway, or drill and tap for a setscrew, and remove burrs.

6. Lay out, drill, tap, and remove burrs, including the two 5/32" holes at the bottom of the slots.

7. File out two slots for the starting cord.

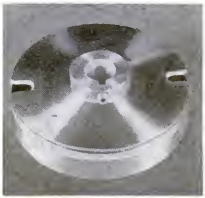
### PART 9, TIMER CAM

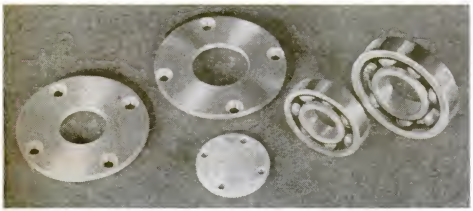
1. Drill, countersink, and part off.

the face, the shoulder must be turned the full 3/16" length shown in the drawing. It is not necessary to rough out the maximum outside diameter or the chamfers, but it will do no harm.

Stub arbors and nests provide a sure method of obtaining concentricity between fits when they cannot be bored in one chucking. Such pieces are made of scrap stock chucked in the lathe and turned and polished to fit snugly the

**Below are completed retainers, a cover, and ball bearings. At right are views of the flywheel from the front and back. The starting-cord groove and slots can be seen in the front view at top, and the assembled timer cam in the lower photo.**





part that will be mounted on or in it for turning. An arbor or nest cannot be used again after it has been removed from the chuck unless it is turned down smaller or bored out larger for the next job. Be sure to oil mating surfaces before using.

The importance of concentricity between fits cannot be overemphasized. Wherever possible, all diameters should be turned or bored at one chucking. However, the .502" diameter on the crankcase cover must be concentric with the fits on the opposite side, so concentricity is obtained by mounting the cover in a nest and locating from the 1.499" diameter and shoulder for boring. Concentricity is necessary here so the rotary-valve end of the crankshaft will float free in the .502" bore and the latter will not act as a bearing or cause interference when the motor is running.

By a push fit for the ball bearings is meant one that will allow a ball bearing to be pushed into its housing with the fingers—a snug fit. The best way to obtain this fit is to use the ball bearing for a gauge. Mount it on a makeshift handle between two washers that will keep it clean.

Hold the ball bearing square when attempting to fit it, for if it is cocked it may cause you to misjudge the size of the bore and lead to taking off too much stock. The depth of the bores is .003" less than the width of the bearing so the retainer will hold the bearing in its proper position. A ball bearing is a precision unit and must be handled carefully and kept meticulously clean both during the fitting and the final installation.

Directions for making the model gas engine are being presented in three installments to provide plenty of space for a full discussion of each part. The parts to be taken up next month include the cylinder, piston, and connecting rod.

The ball bearings, bar, rod, and sheet stock called for in the list of materials can probably be obtained by most readers from the larger hardware stores, jobbers, salvage or war-surplus stocks, or mail-order supply houses. However, as an accommodation for those who cannot obtain the materials elsewhere, a kit containing the ball bearings, timer points, timer-cam stock, and alloy-steel screws and wrenches is available. Some of the bar and rod items needed can also be supplied.

### TAP DRILLS

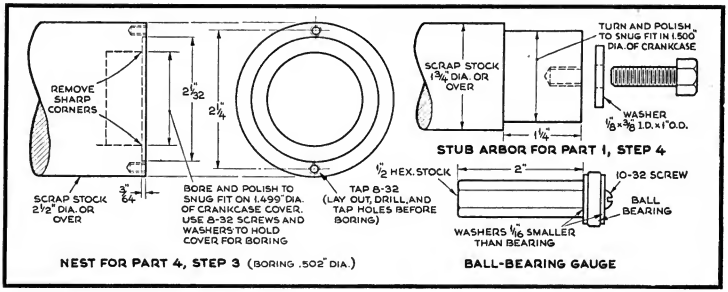
Be sure to use the proper hole size for tapping. For convenience and to prevent error, the tap drills to be used for the various tapped holes are given here.

| Tap size | Tap-drill size | Pct. of thread |
|---|---|---|
| 2-56 | No. 50 (.070" dia.) | 70 |
| 4-40 | No. 43 (.089" dia.) | 71 |
| 6-32 | No. 36 (.1065" dia.) | 78 |
| 8-32 | No. 29 (.136" dia.) | 69 |
| 10-32 | No. 20 (.161" dia.) | 71 |
| 3/8"-24 | .333" dia. | 75 |

Note: The four 6-32 tapped holes around the cylinder seat of the crankcase hold the cylinder in place and absorb the shock when the engine fires. Tap carefully to obtain maximum thread strength.

### LIST OF MATERIALS

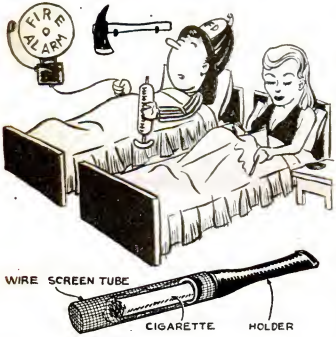
| Part No. | Description | Size |
|---|---|---|
| 1 | Dural bar | 2" sq. by 1 3/4" |
| 2 | Brass tubing (.032" wall) | 7/16" O.D. by 1 1/4" |
| 3 | Dural rod | 2" dia. by 1 1/4" |
| 5 | " sheet | 3/32" by 2 1/2" sq. |
| 6 | " " | 3/32" by 2 1/2" sq. |
| 7 | " " | 3/32" by 2" sq. |
| 8 | Machine steel | 2 3/8" dia. by 1 1/8" |
| 9 | Fiber or bakelite | 3/8" dia. by 1" |
| 10 | Ball bearing | .375" bore, .875" O.D., .218" wide |
| 11 | " " | .500" bore, 1 1/8" O.D., .250" wide |



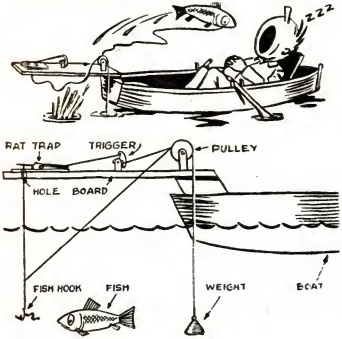
# WHAT'S YOUR INGENUITY QUOTIENT?

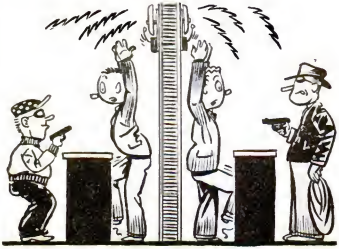
*Have you pulled off a smart one lately? We will pay for each contribution accepted for this page showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.*

**A FIRE-FIGHTER AT HEART,** I tried to cure my wife of the smoking-in-bed habit. Defeated—naturally—I rolled and soldered a wire-screen tube. Encased as shown, the cigarette can't come into contact with the bed covers—IRA MINOR.

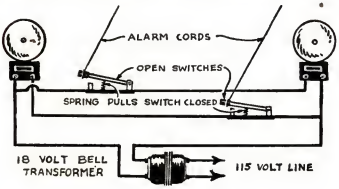



**FISHING IS FUN,** but it also feels like work when I want to sleep in the summer sun. To combine my two hobbies, I rigged up this lazy-fisherman's friend. Tugging at the hook, the fish springs the rat trap, which releases the weighted line and promptly yanks him aboard.—RUDY DEMIAN.



**EVER ARGUE WITH A GUN?** People who do sometimes get hurt. So when a flurry of holdups threw some of our local storekeepers into a dither, a couple of us turned to mutual aid. A bell in my store is actuated by a spring-closing switch in the one next door, and vice versa. Extra switches can be added in parallel with the first. Breaking the alarm cord completes the circuit and gives the alarm. If the other fellow doesn't have his hands full—or up—maybe he'll send for the cops.—MAL BLUMBERG.




**REACHING FOR THE MOON?** No. It only seems like that when a dangling wire or cord remains a few feet away from your longest stretch. Trying to pull in a hanging antenna lead-in outside my window made me think of this scheme. I looped a piece of heavy cord at one end of a long pole, gave the free end of the cord a tug, and had the out-of-reach wire neatly lassoed. In a second I had my hands on the elusive wire.—RUFUS P. TURNER.

# WHITTLED *model of the Nazi* "BURP GUN"

**The Schmeisser MP 40 was Germany's fast-shooting version of our Tommy gun.**

This model, with folding shoulder stock, was standard equipment for Hitler's paratroopers. Infantry officers got a modified type.

By CARL G. ERICH

AMONG the memories that American soldiers brought back from the European war are some sounds whose echoes will never die: the constant drone of aircraft; the whine and crash of artillery; and the deadly, spluttering sound of the Schmeisser machine pistol that won for it the name "burp gun".

Firing pistol ammunition at a rate of up to 540 rounds per minute, the gun is fed by a vertical magazine holding 32 rounds. With the folding shoulder rest extended, it measures 32½"; its weight, without the magazine, is 9 lb.

The model shown here is half size, but the drawings can be scaled larger or smaller as desired. For a half-size model, trace the enlarged drawing onto 1" by 4" by 12⅜" white pine or similar wood, and jigsaw roughly to shape. Scribe a center line all around the blank so that the cardboard templates can be fitted to the same contour on both sides.

Start carving from just behind the barrel sight, working toward the back. Razor-sharp carving tools, a wood-burning iron, a few files, and an assortment of sandpaper are all the equipment you'll need. Keep a keen edge on all your knives and work slowly and carefully.

After the barrel has been shaped, you will be ready to carve the magazine receiver, as shown at *I*, and the magazine itself, *J*, which is a separate piece of white pine doweled to the receiver. A cross-hatched disk 1/16" thick is glued and bradded into place at *K*.

The channel for the bolt *O* is routed on the left side only, and the bolt handle *D* is

The right side of the Schmeisser model, above, repeats the basic design of the left side, but with fewer details.

cut separately and glued in place. Sling assemblies (*C* and *R-1*) consist of narrow slots; *C* was made separately and glued onto the barrel. The ejector plate on the right side of the receiver *I* is simulated by means of a shallow V-cut as shown.

Make the shoulder stock *H* separately. This may require two or four pieces of wood exclusive of the butt plate *T*. Grooves *H-1* are burned around with an iron. Plate *T* is joined to the arms by means of tiny sheet-metal angles. Fasten the stock to *R* with a short dowel, and, on the left side, cover the dowel with a 3/16″ cap as at *G*. The shoulder plate *T* either may be fitted rigidly to the stock, or pivoted to simulate the swivel action of the original gun.

Carve the trigger, trigger guard, and forward sight last, working against the grain as much as possible to give strength to these fragile members. If they should split, the parts may be glued together.

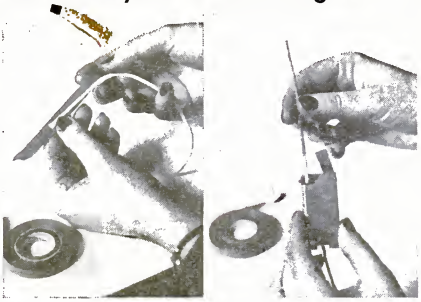
To give the model an authentic metallic appearance, apply a coat of liquid stove polish to all parts except the handle *P* and the stock *N*. After the polish is dry, rub on a liberal amount of powdered graphite, and cover with clear varnish. The varnish will soften and blend the graphite. When dry, rub very lightly with fine steel wool, and apply some more graphite. This treatment gives the metal parts the appearance of blued steel.

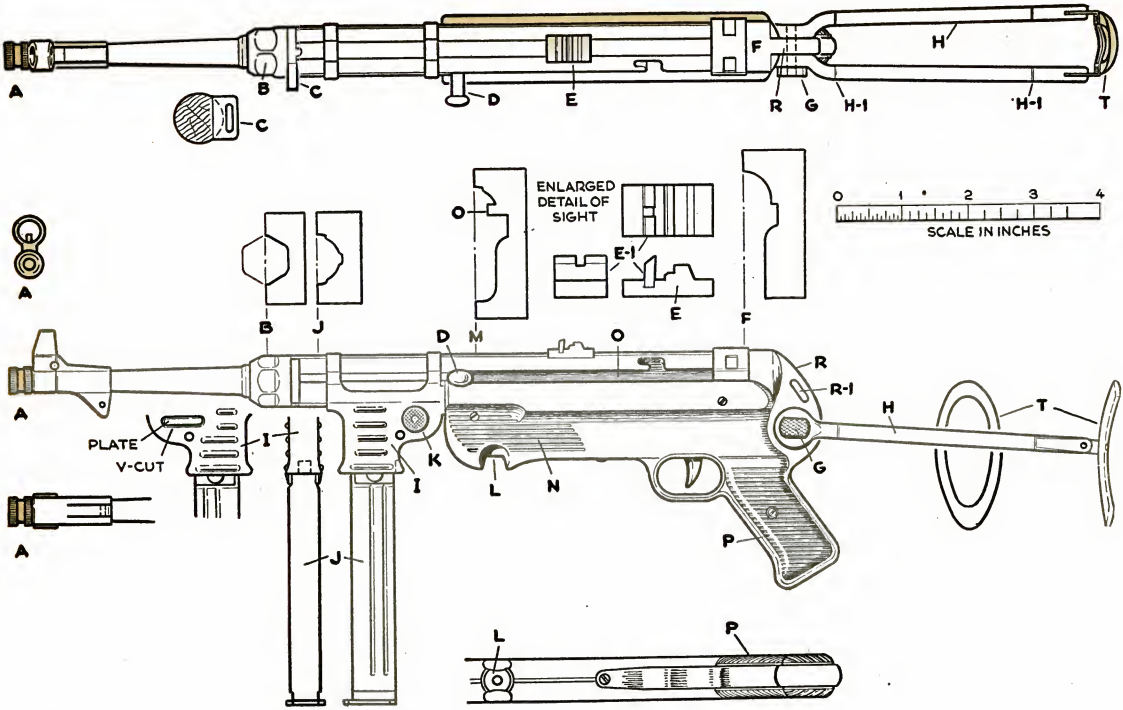
On the original, the frame and grip are made of plastic; to imitate the appearance of these parts, finish *N* and *P* with a dark brown enamel.

An interesting feature of the original was the lack of wood, construction being entirely of pressed steel and plastic.

## Cellulose Tape Makes It Easy to Put Wick in Lighter

FRUSTRATION may be your lot if you try to thread a new wick into a cigarette lighter without some method of stiffening the wick. Using a wire as a prod will do the job, but the trick shown at the right is generally easier. Tear off several inches of cellulose tape, attach to one end of the wick, and roll the tape into a spiral point. When the wick is threaded in place, tear off the tape.—BOBBIE BAUGHN.




A
B
C
C
D
E
F
R
G
H-1
H
H-1
T
ENLARGED DETAIL OF SIGHT
O
E-1
E
0 1 2 3 4
SCALE IN INCHES
A
B
J
D
M
O
F
R
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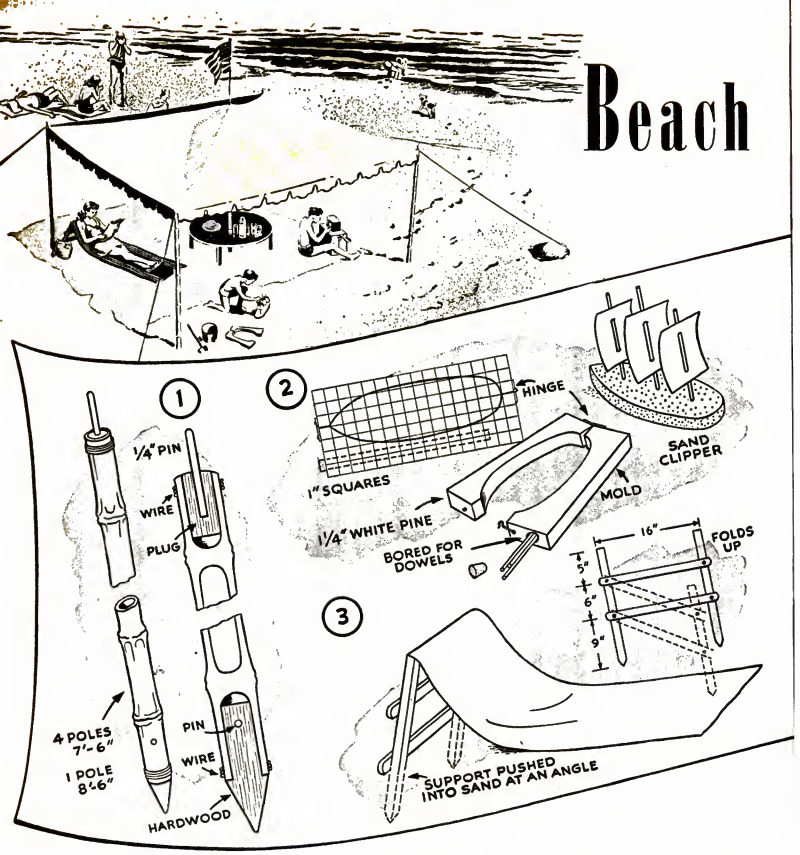
# Beach



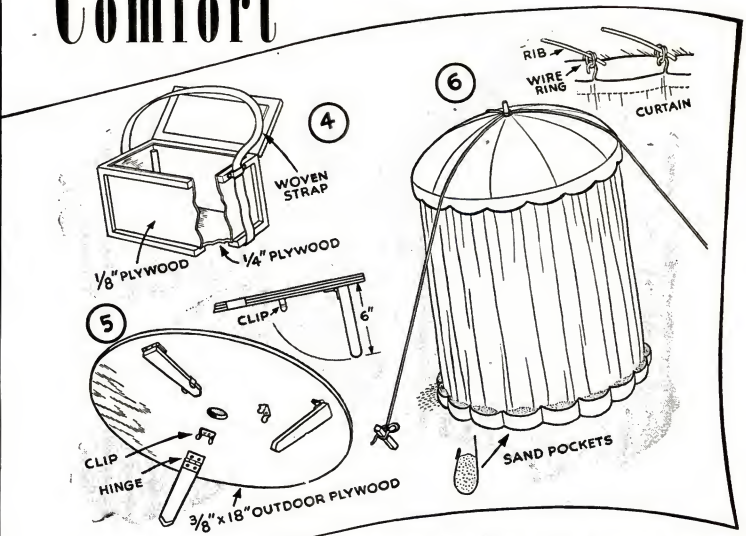

PACK your beach kit with items like those shown above, and no one can complain of discomfort at your next outing. A shelter awning put up on bamboo poles, as indicated at the top left, will protect the family from too much sun at one time and also keep your belongings dry in case of an unexpected rain. The piece is simply a rectangle of awning cloth supported by five poles, the center one 12″ longer than the others. All have pins in the top to push through the awning and shouldered hardwood plugs at the bottom, as in Fig. 1. Sandbags hold the guy ropes taut.

Junior can be kept amused with a wooden mold (Fig. 2) for making sand clippers, and others in the party may be made comfortable on canvas sheets with folding back supports (Fig. 3). The box shown in Fig. 4 is made of plywood to any suitable dimensions and serves the double purpose of carrying food and acting as a bench to keep the portable radio out of the sand.

A low table (Fig. 5) is convenient for picnicking. The middle awning pole goes through the hole in the center. Three legs will keep it steadier than four.

For a dressing tent, hang a curtain around a beach umbrella. Sand pockets in the hem hold the sides down—HI SIBLEY.

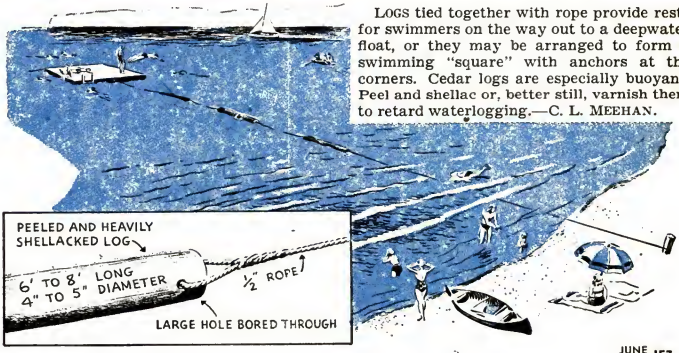
# Comfort




Accessories like these will help make your next beach outing a success for the entire family. From the shelter awning at the far left to the dressing tent above, they are designed for convenience. You can stow them all on the car.

## Chain of Floating Logs Serves as Rests for Tired Swimmers

LOGS tied together with rope provide rests for swimmers on the way out to a deepwater float, or they may be arranged to form a swimming "square" with anchors at the corners. Cedar logs are especially buoyant. Peel and shellac or, better still, varnish them to retard waterlogging.—C. L. MEEHAN.



# GLAZING... *the* PROFESSIONAL

By JOSEPH ARONSON

PAINTED effects familiar on fine furniture have little in common with ordinary two- or three-coat semigloss or enamel finishes. The latter can be taken straight from the can, and a smooth, full finish is easy to obtain with good brushing over a well-sanded surface. A painted finish with a soft, decorated look, however, must be built up by a variety of careful steps, as shown in the photos below of an antique glaze being put on the decorations of a Pennsylvania Dutch chest (PSM, Apr. '46, p. 152).

This craftsmanlike type of paint finish begins with a sealer, such as a coat of shellac or prepared primer, put on over the raw wood. Then all cracks and surface defects

① Turpentine, japan drier, and linseed oil are the vehicles for the colors, which may be bought either in a tube or a can. Raw or burnt sienna or umber, ocher, Vandyke brown, and black are chiefly used, with only enough in the oil for a translucent smudge. A soup plate is a good mixing dish. Soft, old brushes and soft rags are needed.

② Swab a smudge of the oil mixture on freely. Don't be frightened by the disreputable look that is taken on. Begin smearing in the crevices and don't let the fluid accumulate in the corners.

③ Using a soft, old brush, draw out the excess fluid from the corners before tackiness can set in and make removal difficult. Some of the oil smudge has been wiped off at the center or high-light part of the panel shown here.

# TOUCH on fine craftwork

are filled with a filler compound like Swedish putty, the surface is sanded smooth, and two coats of good flat paint are applied, the last being the finish color but somewhat brighter and lighter than the final shade desired.

Decorating is done at this stage, and the antiquing or glazing follows. The decorations must be applied on a well-sanded surface, and good oil colors mixed fairly heavy in japan drier should be used. They may be applied in stripes, ornamental features, stencils, transfer patterns, or any of the familiar decorating methods desired. Antiquing is a process of shading with a thin wash or "glaze" of colored oil that softens the colors and outlines and blends the tones. It is shown step-by-step in the photos.

4

Wiping and texturing are done with wadded pads of cheesecloth. Don't scrub the fluid off. Just wipe off enough to leave a thin glaze over the point and to produce the shade and texture you want. Antiquing of the right-hand panel under the arm in the photo has been completed; that on the panel at the left has not yet been started.

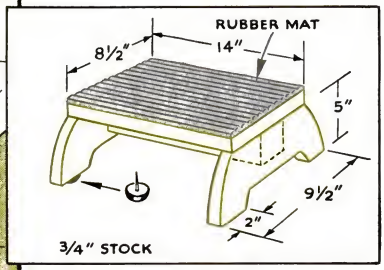
5

Begin the wiping process at the middle, and then work the smudge out from the corners and back into the cleaned-out middle or high light. This blends the shading to accent both the decoration and the molding that frames it.

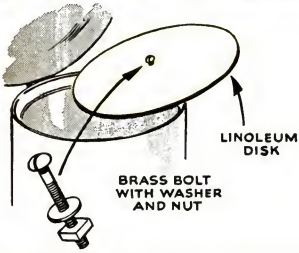
6

Palm and fingers can do a perfect job of final redistribution if you don't mind dirty hands. Rub with a rotary motion, removing excess fluid from the palm as fast as it starts to smudge. When the glaze is dry, protect it with a coat of white shellac rubbed to a satin finish with pumice and crude oil.

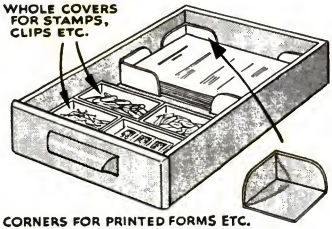
# KEEPING




A footstool just for the youngsters speeds up the process of teaching them to wash themselves. Extra wide legs, a rubber mat, and rubber-headed tacks prevent upsets under lively little feet. A piece of two-by-four, shown dotted, reinforces the legs.



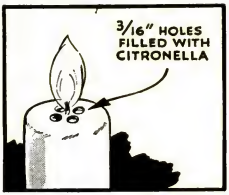

When the bottom of a garbage can rusts through in part, a disk of heavy linoleum cut to fit freely inside will keep the can in service. A loose bolt lets you lift out the disk for occasional cleaning.



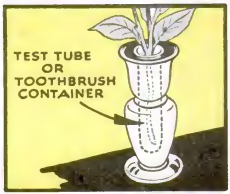

Box tops thumbtacked to the floor of a desk drawer will keep pins and other small items in convenient order. Corners of box tops may be arranged to hold any size stationery, and sheets are easy to remove.

Surplus white shoe cleaner is unsightly on the dark edge of the sole. You'll find it easier to wipe off if you have coated the edge with colorless nail polish.

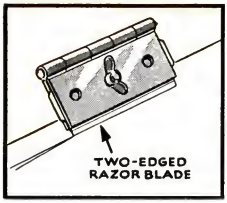
To shoo flying pests, try this homemade insect repellent. Fill holes 1" deep in a plumber's candle with oil of citronella. Plug with wax to prevent evaporation.



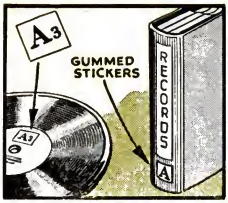

Many small vases aren't practical for holding live blossoms because they are porous. A test tube or plastic toothbrush container is an easily cleaned watertight liner.



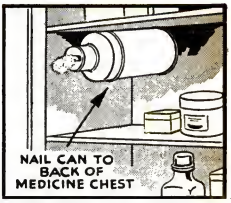
# THE HOME SHIPSHAPE



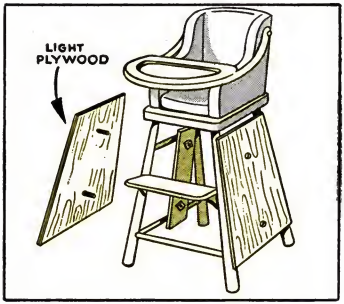

Need a razor-blade holder? Just find a hinge a bit longer than a double-edged blade, put in the latter, and clamp with a small bolt and wing nut as shown above.



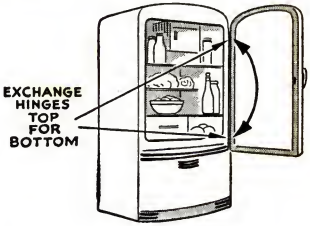

You needn't trouble to read the titles to replace records in the right albums. Put a sticker on each record with the key letter of the album that it came from.




A cotton dispenser is easily made from a talcum-powder can. Punch a slot in the top and pry open at a joint to fill. Mounted as shown above, it takes up no shelf space.

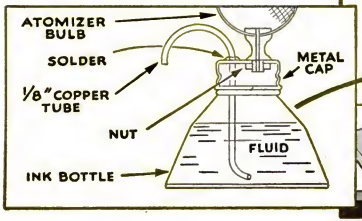



To keep a child from climbing the rungs of a high chair and possibly toppling over with it, attach plywood shields with wood screws or with bolts through a cleat as above. Finish like the chair.



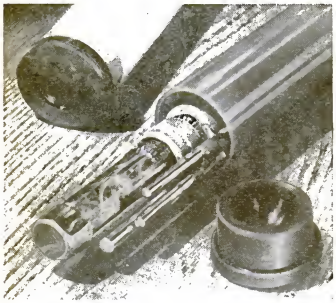

One reason refrigerator doors eventually fail to latch is that hinge-pin holes wear at the inside of the top and outside of the bottom hinge. Just interchange the hinges to eliminate this trouble.

Refuel your cigarette lighter at this handy filling station, which virtually eliminates spilling and evaporation. Old atomizer parts, an ink or mucilage bottle, and copper tubing do the trick.



New plastic-cased alarm clocks made by GE for 115-volt, 60-cycle A.C.

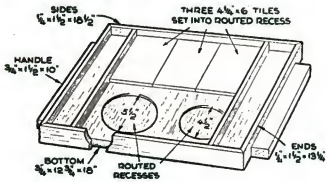
**TRICK ALARM CLOCKS** have been developed by General Electric to awaken both determined and twitchy sleepers. The dark-cased clock at the left above is connected to a radio to wake you with music or commercials; if that doesn't get you up in a few minutes, a buzzer automatically adds to the din. The clock at the right above, for either the hard-of-hearing or persons who don't wish to disturb others, flashes a bright light in the sleeper's face. A third clock, not shown, has a buzzer that is adjustable, GE says, to make sounds ranging from a gnat's whisper to a fearsome racket.



**FISHING-ROD CONTAINERS** of plastic are light, shatter-resistant, and won't dent with hard use. Whether tossed in the back of the car or perched on a crowded closet shelf, treasured fly-casting rods are thus safeguarded from mishap. Extruded of Tenite, the containers are $1\frac{1}{2}''$ in diameter and a little over 3′ long. The end is closed with a rubber plug that keeps out dirt and damp.

**DOUBLE-ENDED LAMP.** With an ultraviolet sun lamp in one end and an infrared heat lamp in the other, this ivory-enameled fixture for bedroom or bathroom will equip the householder for all his special-light needs. The Select-o-ray, manufactured by Westinghouse, has a three-position switch, a combined floor and table stand, and a friction mount that permits it to be adjusted to and held at any angle. To produce the ultraviolet and infrared rays, the fixture uses two standard-base, internal-reflector bulbs, the ultraviolet one a self-ballasting type.

**NOTHING ROLLS LIKE A BALL,** as is well known to playful kittens and to knitters who must frequently retrieve balls of yarn from beneath the couch. The "Yarn Top," a plastic spindle with a weighted base, keeps balls of yarn or crochet thread from wandering afield. Yarn need not be pulled off in short lengths during use, and it does not twist as the ball rotates, assuring that the knitted article will not have a turned-up edge. The Allied Appliance and Plastic Company of Los Angeles makes the device.



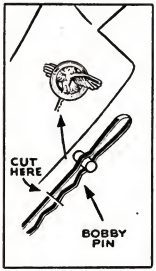

# THREE TEA TILES ON CEDAR TRAY

TEA tiles set into a recess in the floor of this tray make it ideal for serving hot drinks and dishes as well as cold and also add a touch of beauty. If tiles of your choice differ in size from those shown, dimensions should, of course, be changed.

Aromatic red cedar of the kind used in chests gives the tray a pleasant odor. The floor is built up of three boards rabbeted on the inner edges for glued joints. A rectangular recess is routed out to take the three tiles and two round recesses for dishes and the like are routed as shown.

Sides and endpieces are mitered for corner joints and, with the strips setting off the end compartments, are glued in place. Handles slightly recessed on the underside are attached with dowels put through the endpieces into the floor. The tray is shown in color on page 120.—ELMA WALTNER.

## Bobby Pin Holds Lapel Emblem




DISCHARGE buttons are apt to be lost from the lapel of lightweight suits unless some means are taken to anchor them on securely. One way to do this is with a bobby pin put over the shank of the button behind the lapel. The bobby pin may be cut short and shaped if desired, by squeezing with pliers over a small nail.—E. H. GODFREY.

## Stamp Pad Inside Desk Drawer

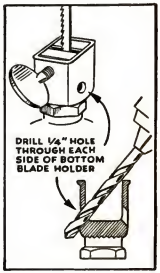
IF YOU frequently use a narrow rubber stamp, such as a date stamp, a pad screwed to the inside of a desk drawer will be handy. Glue a strip of felt to the edge of a block and saturate the felt with mimeograph ink. Inking will hardly be required oftener than once a month, and the block can be unscrewed for the job if preferred. No cover is needed for the pad. —D. H. MATHESON.

## Dentifrices Shine Up Plastics

AS A kink in getting a higher luster on plastic pieces being worked, try polishing them with two kinds of common dentifrice—tooth powder and tooth paste. Rubbed in briskly with a small piece of felt, tooth powder and water will easily remove small marks in the surface; then use the tooth paste to give a high polish to the sanded ends and sides. Don't reuse the same piece of felt.—FRANCIS E. HOLMES.

## Cleanout Holes in Blade Holder

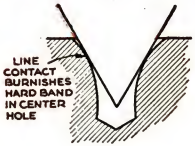
SAWDUST won't clog the blade holder at the lower end of the jigsaw if you drill a hole in each of the two sides, as shown in the drawing at right. Much of the sawdust that collects around the bottom end of the saw blade will escape of its own accord through the holes while the saw is in use. What remains can be blown out easily when the blade is removed. Dust left packed in a holder often makes it difficult to obtain a good grip when a new blade is put on.—A. G. OGREN.

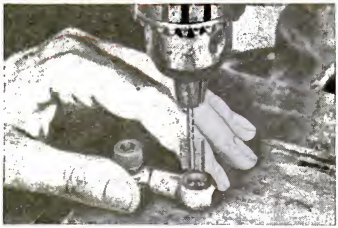


# NEW TOOLS

**MULTIPLE GAUGE SETUPS** are possible with this kit made by the Doall Company of Minneapolis. Used in conjunction with gauge blocks, the kit will permit almost any kind of inspection gauge to be assembled within five minutes. One unusual combination is an angle comparator having two dial indicators; when an angle identical to that set up with a sine bar is tested, the dials read alike. Another is an indicating square gauge; the work is simply pushed against a stop and an indicator tells if its side is precisely 90 deg. Also included is a set of accurately lapped wires of various diameters.

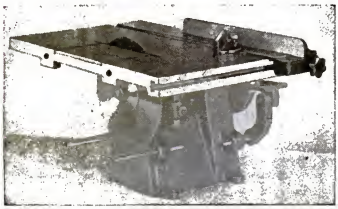
**NEW CENTER DRILLS** without the usual 60-deg. countersink have been developed for use on work to be mounted between machine centers. The Hy-Co drill produces a center hole having a curved section, which is said to result in a burnished, narrow-band seat that stays true under load. The drill has a relieved tip that may be easily removed if broken in the work.

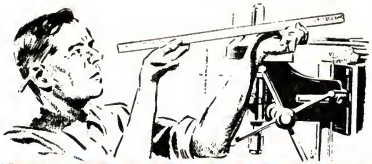


**TINY POWER BRUSHES** fit many hard-to-reach spots and are handy for removing rust, burrs, and mold marks as well as for general finishing and polishing. Sold in sets of twelve by the Osborn Manufacturing Co. of Cleveland, the wire brushes may be used in drill presses, electric drills, flexible-shaft tools, lathes, and bench grinders with chucks.

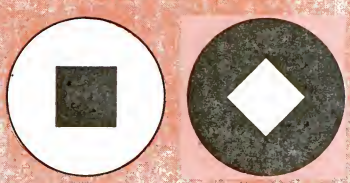
**PACKAGED WORKSHOP.** Designed for home shops and light manufacturing, this power tool combines a circular saw, grinder, sander, and buffer. Set up as shown at left below, the tool has a grinding wheel at one end of its ball-bearing spindle and an abrasive disk at the other. To convert it to a saw (right below), the sanding table is removed, an 8" circular saw replaces the sanding disk, and a cast aluminum saw table is attached. The latter tilts to 45 deg. and has a miter gauge, rip fence, and an adjustable plate for the use of a dado head. The Parlec Tool Company, Inglewood, Calif., makes it.



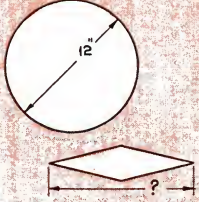


# HOW'S YOUR Shop Eye ?

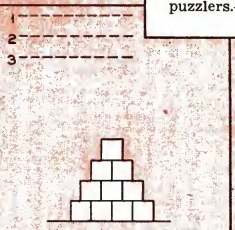
CAN you tell a straight line from a hole in the wall? When you're working to tolerances of .001", you naturally take the slow method of micrometers and calipers, but for spot checks and quick guesses, a good shop eye is an invaluable asset. Test yours on this assortment of optical puzzlers.—RONALD EYRICH.



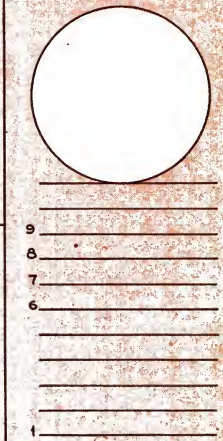
**1** If you can discount the effect of color contrast, you'll have no trouble naming the larger square.



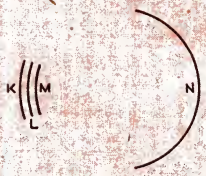

**2** Relative to the circle, the diamond is 11", 12", or 13"?




**3** In a single stack, to which line would the blocks come?




**6** Resting on line 1, to what line will the circle reach?




**4** If circle N were completed, would it meet K, L, or M?

**5** Are the heavier lines above really straight, or curved?

ANSWERS: 1. The black square is larger. 2. The diamond is 1/12 longer than the diameter, therefore 13". 3. To the top line. 4. N and M are arcs of the same circle. 5. The lines are straight. 6. To line 8.

# FORMS for CONCRETE SLAB FLOORS

## FIRST OF A SERIES ON HOW TO BUILD SMALL STRUCTURES

### By EDWIN M. LOVE

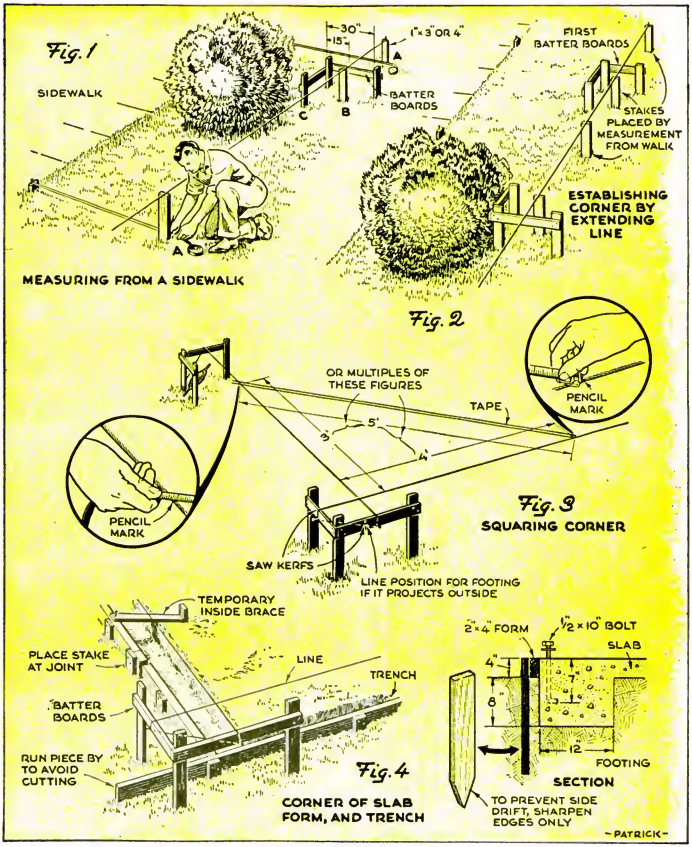
SLAB floors of poured concrete are excellent not only for shops and garages but also for store buildings, offices, and residences that do not require a cellar. They are particularly suitable for amateur construction, since they reduce form building to a minimum and eliminate complicated sill arrangements, the labor of placing and leveling floor joists, and the installation of bridging and underpinning. In many instances, such construction also costs less for materials.

The initial problems in building are locating the structure on the lot and squaring and leveling the foundation form. Usually it is sufficiently accurate to come within 1″ or 2″ of the planned spot, but closer limits are easy to attain. A base line from which to measure may be the edge of the front sidewalk, a line stretched between surveyor's corner stakes, or a center line in the street or road if there is no sidewalk. Occasionally a building already on the property will serve the purpose.

A method of laying out the side of the building is shown in Fig. 1. Stakes at two well-separated points at the edge of the sidewalk have nails driven in at the tops to catch the ring on the tape. Measure from these points to locate two stakes *A-A*, and mark accurately on their sides; then transfer the measurements to the tops by use of a level. Cut a saw kerf in each to receive a mason's line stretched between them.

Next, locate an approximate corner stake *B*, by measuring from the side of the lot, and then drive three plumb stakes, as at *C*, forming a corner well outside the temporary stake *B*. Nail on batter boards leveled a few inches above the floor to be laid so as to allow for grade slope and to keep sagging lines from touching the ground. This corner

Leveling is done between stakes, with each stake marked and a nail driven in to support the straightedge.




is a rigid assembly out of the way of the form and trenches.

Drive a corner stake for the second corner at the established line and erect batter boards. Locate the level height on succeeding stakes with a transit, if possible, or by using a long straightedge and a carpenter's level, as in the photo on the facing page. Rest one end of the straightedge on a batter board and mark the level on a stake driven near the other end. Drive a nail at this mark, rest the straightedge on it, and set a second stake, repeating until the far batter boards are reached. Turn both the straightedge and level end for end at each new stake so any error in either will be largely canceled out. It is not unusual to find a discrepancy of ¼" or more at the last stake, but this can be overcome by working in both directions from the first corner and doing a little "dividing up."

With two sets of batter boards placed, mark the position of the line with a plumb bob and saw shallow kerfs to take it. Then

When batter boards are being placed for a second corner and the established line does not reach, extend the line over the second measured stake, as above. Shift the line to align with a saw kerf in the stake and mark it on the batter board.

Approximate squaring of a line to locate a far corner is done by sighting on a framing square lying on the ground. Below, a screed cleated to slide on the side of the form reveals uneven spots on the base surface.

mark the position of the next side by measuring from the edge of the lot, and mark the third by measuring from the second.

Sometimes the established line measured directly from the sidewalk doesn't extend to the second batter board (Fig. 2). In a case of this kind, do not fasten the line to the nearer stake, but extend it to cross the batter board, shifting until it is aligned with the stake kerf, and then mark it on the batter board, as shown at left above.

To locate a rear corner, lay a framing square on the ground with the blade parallel to the first line, determining the position by sighting, as in the photo at top right. Watch as a helper unreels the line, signaling him to the right or left. Measure the length of the side, and drive the approximate stakes; then place the batter boards. Sight along the blade of the square as the helper tightens the line and ties it. Figure 3 shows how the sides are accurately squared by measuring along the lines and marking them with a pencil. When the lines are square, a measurement between the pencil marks will be in the proportion shown. If adjustment is needed, shift the rear end of the second line.

Place the approximate stake and the batter boards for the fourth corner by measuring from the second and third corners, and make a final check on squareness by measuring diagonally between line crossings.

It is of course desirable to have the floor above the grade line to keep water out during storms. If the slope of the lot is slight, place the 2" by 4" form members directly on the ground at the lowest corner and cut into the higher ground as necessary to level them. Establish the corners by dropping a plumb bob from the lines to the inside faces of the forms, and drive stakes at all joints and at other points so no two stakes will be more than 8' apart: Establish corner levels by measuring down from the lines, and then level from joint to joint with the straightedge and level. Blocks of equal thickness tacked to the ends of the straightedge will prevent it from riding on high spots in the form. Straighten members by sighting along them and over the lines. Saw part-way through any out of line and spring them back into position, holding

them with stakes driven in. Two 6-d. box nails are sufficient in each stake. Temporary shores or braces, to be removed as the slab is poured, will support members that sag inward, as in Fig. 4. The ends need not be cut off if one can overlap.

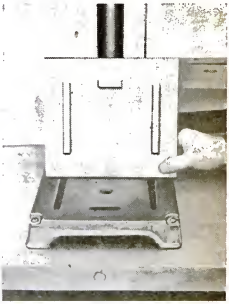
Dimensions of the footing trench will vary according to locality and should be determined by local practice. Those suggested in Fig. 4 should serve in mild climates, but before starting to build, it's wise to obtain minimum requirements from the city or county building office, as penalties are often severe for violations of building laws.

Dig smoothly, since irregularities waste concrete and do not strengthen a foundation or floor. Excavate for the floor by digging out high parts and throwing the dirt into low sections for firm tamping. All tree sprouts and live roots should be dug out. Gauge depth with a leveling strip or screed made from a length of two-by-four with cleated ends to slide on top of the form, as in one of the photos on the facing page.

Mark bolt positions on the form, spacing them 6′ apart, or according to building laws, and 2″ inside the edge of the slab. Place one about 10″ from the outer corner at the end of the side from which studding is to be placed, and then measure from there. If this is not done, some bolts may come in a stud position and make notching necessary.

## Plywood "Pan" Keeps Chips from Under Base of Drill Press

SCRAP plywood can be made in a few minutes into a "chip pan" to fit the drill-press base, as shown at left, and prevent litter under the machine. Cut the plywood to the outline of the bottom table, nail cleats to the underside, as at right, for a snug fit in the slots in the base, and then paint it. Chips may be brushed off as necessary during work, or the "pan" may be removed and emptied after each job.—D. J. BACHNER.



### MIXING CONCRETE [HANDY MAN]

Thorough mixing of the cement, sand, and aggregate is necessary for concrete. If the job is large, it is best to borrow or hire a mixing machine, but the mixing can be done, if necessary, on a platform about 8′ by 14′. Make the platform of 1½″ to 2″ stock, preferably tongued and grooved, and nail strips on three sides so no cement will be washed away and lost. The platform should be near the site so the concrete can be shoveled directly into the forms.

An average wheelbarrow will hold about 2 cu. ft. of sand or crushed stone and can be used for measuring. Or the materials may be shoveled into a bottomless box placed on the platform and then lifted away. One 12″ high by 24″ by 24″ inside will hold 4 cu. ft. Lines marked inside at 3″, 6″, and 9″ heights will measure 1, 2, and 3 cu. ft. One bag of cement measures 1 cu. ft.

Put the sand on the platform first and spread the cement on it evenly. Mix thoroughly with a shovel, first dry and then wet. Spread out the mortar, put the crushed stone or other aggregate on top, and mix thoroughly, adding more water as required. Light aggregate may also be mixed dry with the cement and sand before water is added.

A minimum of water produces the greatest strength in the finished concrete, but be careful not to use too little, as that would prevent proper mixing. Generally, when the sand and aggregate are dry, a minimum of about 5½ gal. to each bag of cement will be found about right. Less water will be needed, of course, when the materials are wet. The water used must be free of all impurities. To be suitable, it should be fit to drink.

POPULAR SCIENCE MONTHLY SHOP DATA

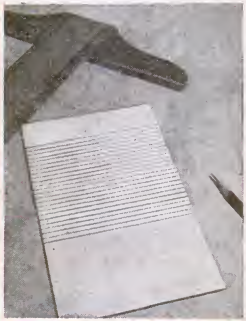
# Workshop Index File

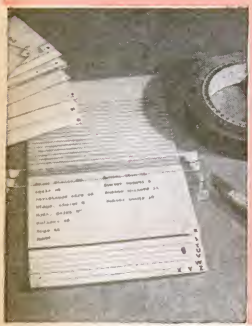
## AN AUTOMATIC MEMORY

WHEN numerous small parts, specimens, tools, and materials are kept in cabinet drawers, an index file is essential for quick location. This one is made of standard file cards attached to a backing with cellulose-tape hinges. The index letters can be seen at a glance. Wood rails screwed to the bottom of the cabinet, if there is room, provide a place for the unit. Though made of cardboard, the index should last a few years, after which recataloguing may be necessary anyway.—WILL THOMAS.

Type or write contents titles on 3" by 5" file cards, leaving space to add later entries. Ink in index initials in one lower corner or use prepared tabs. Letters cut from a magazine would do if glued on.

Make the back of heavy cardboard 5" wide by 7½" or more long. Begin 3" from the bottom and rule it horizontally every ¼". Have a space for each card used and leave a 1½" margin at top.





Cards are put on with tape hinges. A single strip holds, but the cards may be folded up and taped on the back also. Start at the bottom. Leave a blank corner when one letter covers two cards.

Trim the tape even at the sides and cut the top margin off. Add a thin cardboard cover with a tab at the bottom. Make up two L-shaped rails, screw them to the cabinet bottom, and slide the file in.

# REPAIRING a STOVE-IN HULL

By ELON JESSUP

WHEN your ship comes in on the rocks, and you get it on the stocks to find a hole stove in big enough to drop an anchor through, don't be downhearted. Things may not be as tough as they seem—it's often plain sailing to replace wrecked planking with a tight patch. When she's sanded down, brushed off, and then spread with paint or varnish, nobody will ever know your boat had once been ripped open.

Step-by-step repairs on such a hull are illustrated by the photos on this and the following page. Two pieces of planking have been damaged on the 16' cedar boat shown, requiring two new planks for repair.

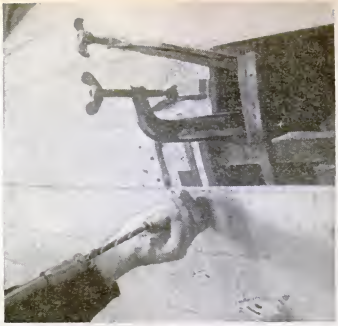
**1** Damaged planking is first cut away to solid wood with a keyhole saw and pried out to the seams above and below. Where abutting planks are damaged, replacements must be of unequal lengths.

**2** Fasteners holding the damaged parts are now useless and should be removed. They can be reached through the hole in the hull and their heads cut off. Then they are pounded through.

**3** This is a key step in the replanking job. An oak butt block of the same thickness as the planking must be cut for backing up the new planks from the inside at each end.

**4** Here a butt block is being fitted. Half of it shows, the other half being covered by the hull. The block overlaps the hole by from ¼" to ½" at both the top and the bottom.

**5** Next, the outer face of the butt block must be curved by planing to fit flush against the natural curve of the inside of the planking. The grain runs lengthwise of the boat.



**6** Hull, frames, and butt blocks are clamped firmly together and held by screws put into countersunk holes. Here a butt has been screwed on, and a screw is being put into the frame.

**7** Then a new section of planking is marked up to fit the lower part of the gap. The stock used should be ⅛" thicker than the original on the boot so it can be planed down flush.

**8** Take care with the planking to get an exact fit, and then bevel the edge for calking. Holes are bored and countersunk deeply, and the screws are put into the butt blocks and frames.

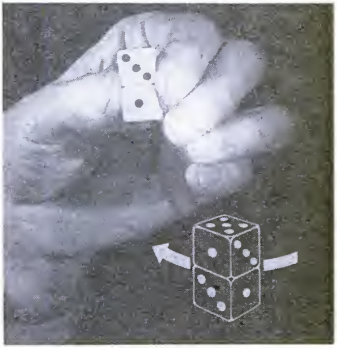
**9** Using a plane, take the planking down flush with the rest of the hull. The screw heads have been countersunk deeply so there will be no danger of striking them and damaging the plane.

**10** Finally, the seams, including those at the butts, are calked tight, and all the screw holes are puttied up. The new planking is then sanded, brushed, and painted or varnished.

# TABLE TRICKS

**COINS DISAPPEAR** without going up your sleeve. To prove it roll up your right sleeve and have a friend grip your right wrist. Show him how by gripping it yourself, as below, and shake your arm to jingle the coins. Then when your friend takes hold, open your right palm, and the coins will have vanished. They were really in your left hand all the time. If you find it hard to hold the coins when releasing the wrist, try gripping it from beneath instead.

**TEARING BOTH ENDS** away from the middle of a strip of paper sounds easy. Actually it's difficult. But you can have a lot of fun in a group of friends if you can work up interest in the stunt. Cut almost through the strip at points equidistant from the ends and make the cuts as nearly even as possible. Try then as you will, one link will always give way first.



**PUTTING MAGIC ON DICE** so the *three* shows over the *one* at one moment and the *one* shows over the *three* the next is mystifying but easy. Of course, you must arrange the dice with the adjacent *three* and *one* faces as indicated in the drawing. Conceal the faces on both sides with the thumb and forefinger, stroke the dice with a finger of the other hand, and while that hand conceals then, give them a quick quarter turn. Don't repeat the trick too often.

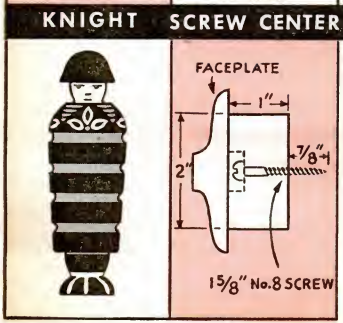
**TOOTHPICKS FORM A STAR** before your eyes if you bend five of them in the middle and arrange them as shown at left. Then let a drop of water fall in the center, and they will jump to the position shown at right. The trick should be performed on a metal or waxed table, and you may need practice in aiming the drop of water.—S. C. DEAN.

# CHESSMEN turned to

CHESS players who are also workshop enthusiasts will derive double enjoyment from this project. Craftsmen not adept at chess will still find interest in the turning, and the set will make an ideal gift.

Use of 1″ maple doweling simplifies the job of turning if the stock is close-grained and free from blemishes. About two lengths will be enough for all 32 pieces with some left over. If you don't have a regular screw center, it will be worth while to turn one of hardwood like that in the drawing below to hold the pieces accurately centered. Drill a ½″ hole for a depth of ¼″ and drive through a wood screw, as shown, so that ⅞″ of the end protrudes. This screw must be accurately centered. Turn the spindle by hand, noting any variation of the revolving point. Bend the point slightly with pliers, if necessary, until it turns true.

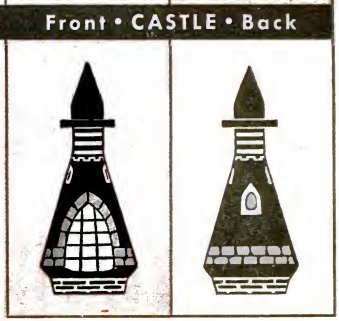
Cut the doweling into required lengths, taking care to saw the ends square, and mark centers accurately on both ends. This is best done with a 1″ disk cut from heavy cardboard. Push the fixed end of the compass all the way through the cardboard, and use this hole as a center through which to prick a mark on the pieces with a small punch or scriber. Then drill a 3/32″ hole about ¾″ into one end and absolutely perpendicular to the face. Screw this end flush



on the screw center and bring the dead center in, oiling it to prevent friction.

If you wish to make the pieces the size shown in the drawings, full-size templates can be directly traced. However, the patterns can readily be enlarged or reduced, using either proportional dividers or photostatic methods. Turn the pieces about 1/32" over dimensions and finish by sanding. Two chisels, ¼" and ½" in size, and a small flat or half-round file will be tools enough. Be sure the chisels are sharp, or chipping may result. As a further precaution against chipping, use the file for a finish cut on all sharp edges, such as the hats.

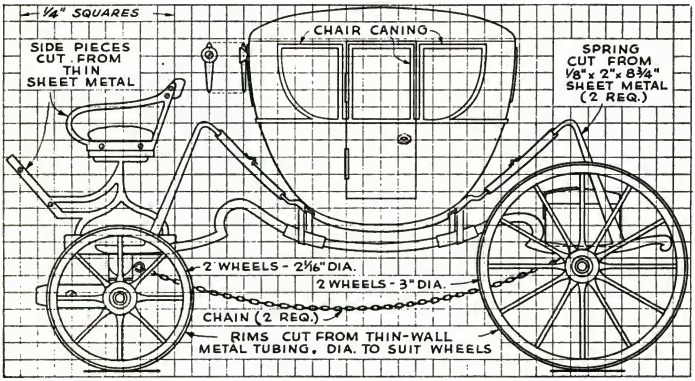
Most of the painting can be done in the lathe as well as the application of a wood filler. Use a good camel's-hair brush and first-quality enamel and run the lathe at a very low speed, if it has one, or turn the spindle by hand. Put on two base coats, black for one set and white for the other. Much of the design can also be put on in the lathe with the tool rest supporting the brush hand. Touches of color, as in the photo on page 120, add interest. If you find the pieces are not sufficiently stable during play on the board, bases can be weighted by boring them out and filling with molten lead, or by cementing on heavy washers and felt disks.—JAMES S. HARTZELL.



IN THESE streamlined times, George Washington's coach may look like an ornate relic of a distant age. But on close examination even the modern eye will be struck by the simplicity of its lines. Perhaps this simplicity appealed to America's first President; certainly the rude roads of the times demanded a vehicle both light and sturdy.

Compare Washington's conveyance, for example, with the British Royal State Coach, built just a few years earlier. The latter was elaborately ornamented and encrusted with gold. In contrast, the head of the United States government contented himself with this relatively simple one.

Two virtually identical coaches were imported from France at the same time, and no one can be sure how many other copies of this pattern were turned out by the same coachmaker. The fact that there were at least two such coaches in America has caused some confusion among the experts. It is known that the one the President used



# MANTEL MODEL OF *Geo. Washington's Coach*

By WILLIAM J. WARD Jr.

This attractive miniature is made of oak and mahogany with brass fittings.

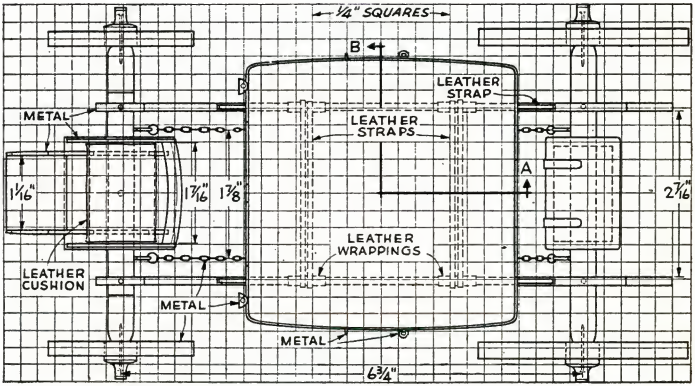
no longer exists, but there is some doubt as to whether the one now at Mt. Vernon, from which this model was copied, is an exact replica.

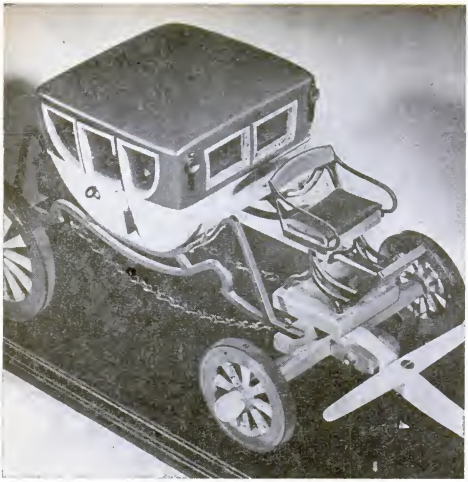
In this hand-carved miniature, the wheels were whittled out of solid oak. More accurate modeling is possible by following the method of the coachmakers of that time. These skilled masters made each spoke individually and then let it into the rim and the hub.

For those who prefer this method, the drawing suggests proportionately thinner spokes. If you enjoy delicate lathe work, you can turn them; alternatively, 1/8" dowel can be sanded or carved to a taper at one end, and to a wedgelike tenon at the hub end. The hubs themselves can be turned or carved of hardwood dowel, or built up of disks of various diameters to afford the contour shown.

The tires for the wheels were made of thin-wall brass tubing, which happened to be available in the right diameters. If you don't have such tubing, cut strips of sheet brass slightly longer than the wheel circumference, screw or brad them to the wood rims, and solder the joints. When the coach is mounted with the joints at the bottom, these will be concealed by the base.

To make the springs and the curved main frame members which join the axles, enlarge the profiles to scale, and trace them onto a sheet of 1/8" sheet brass. Saw the metal with a jeweler's saw, and dress smooth





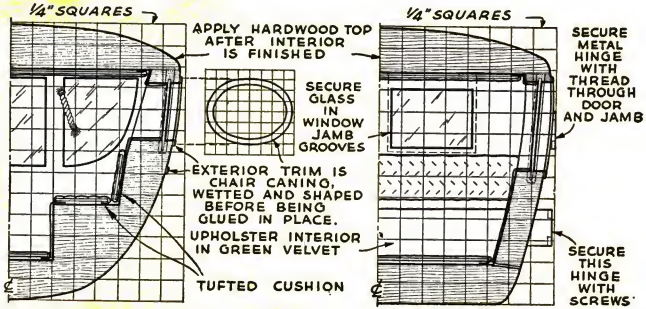
All metal frame members used in this model were cut from sheet stock, but stiff wire will also serve for some parts. Solder joints can be filed to form smooth fillets.

with a file. The curved members directly under the coach body are made of the same stock as the springs, from which they are suspended by leather straps. The coach body is actually cradled on cross straps joining the spring-suspended members.

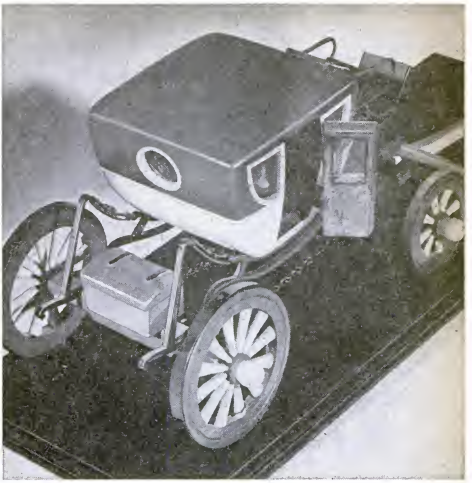
The coachman's seat and footboard support can be sawed from 1/16" sheet stock or alternatively bent from heavy wire, hammered flat where necessary for attaching with escutcheon pins to the seat and footboard. Fillets can be formed of solder. Strap buckles are bent from light wire. The driving lights may be sawed and filed out of 1/8" brass, a glass bead being set into a shallow hole to simulate the glass window.

A built-up block of mahogany was used for the body, the several layers or lifts being dimensioned to afford the setbacks shown in profile section "A." If you have a router, you may find it easier to cut these steps from a solid block.

In this model the windows are actual glass panes, let into grooves in the vertical window members through slots cut in the top crosspieces. A simpler way would be to carve rabbets for the glass from the inside and glue in strips to retain the glass. The strips will later be covered by the green velvet that lines the interior of the coach. Mica, celluloid, or cellophane may be sub-



Side doors swing freely on two hinges. The trunk may be carved as a solid block, but if you like to attend to all details, hollow the box, and hinge the lid on top.



stituted for the glass. The roof is glued on last, and the exterior is shaped and sanded smooth.

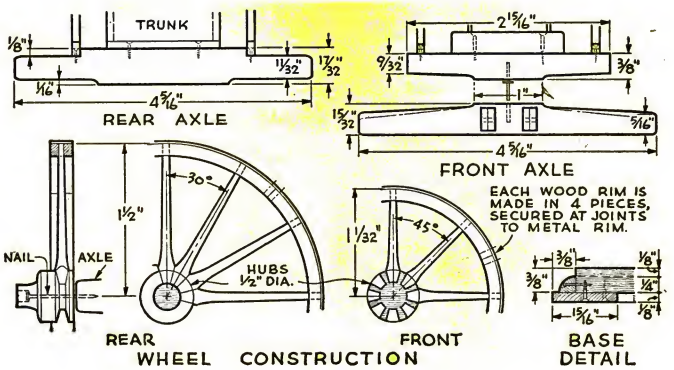
Hinges are made of brass; the lower ones are set with screws, and the upper ones secured with silk thread which is pulled through to the window grooves and tied before the glass is installed. Door handles are tiny, bent screw eyes, shaped with a file.

To make the driver's seat, place a pad of cotton on a sheet of cardboard of proper size, and cover it with thin leather. Fold the leather tightly, and glue it under the cardboard.

Interior seats are similarly made, except that green velvet is used in place of leather. A tufted effect is obtained by sewing tight loops of green thread through the fabric at short intervals. Tasseled hand pulls are suspended from the jambs of both doors. The outside window trim is chair caning, shaped after wetting, and glued in place.

Finish the coach by sanding all surfaces smooth and applying several coats of enamel. The cream-and-green color scheme, shown in the photo on page 120, is taken from illustrations of the original coach.

It is usually a good idea to mount this type of scale model on a permanent display base. Leaving it unmounted may prove too great a temptation to friends who must find out whether the wheels turn.



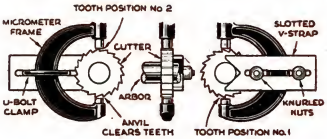
# NEW SHOP IDEAS

**BELT DRESSING** is applied safely in a holder like that below without danger of injury from a running belt. The wood holder is bandsawed to shape, bored with an expansive bit, slotted, and drilled for a clamping bolt.—C. W. W.

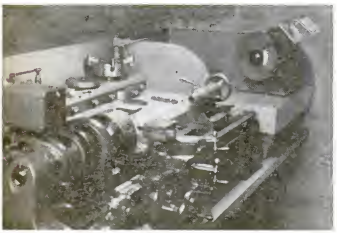
**STEADY-REST JAWS** can be adjusted with accuracy for precision work in the lathe if you happen to have a mandrel of the exact diameter of the workpiece. Mount the mandrel between centers and carefully adjust the jaws to it. Then when the work replaces the mandrel, the work axis (and any boring or other cuts) will be truly parallel to the lathe bed.—C. W. W.

**DIAMETER MEASUREMENTS** of odd-tooth cutters and gears can be taken direct with a micrometer if a slotted V-strap is made and clamped to the micrometer frame as shown in the drawing.

Mount the cutter on an arbor and clamp the V-strap lightly with the *V* well back. Place the anvil on the point of a tooth, as in position No. 1, turn the spindle down to straddle the opposite two teeth, slide the *V* forward snugly against the arbor, and clamp the strap tight. Then release the micrometer, bring the spindle in line with a tooth, as in position No. 2, press the *V* firmly against the arbor with one hand, and adjust the micrometer with the other. The reading will show actual diameter since, while the anvil does not touch a tooth, the *V* holds it in relative position.—H. MOORE.




**BACK BENCHES BEHIND LATHES** are probably the most convenient means for keeping tools, chucks, faceplates, wrenches, and the like within reach. The back bench in the photo at left below extends around the end of the lathe and furnishes a suitable mounting for a tool grinder and electrical outlets. That at right is inclined at an angle and has holes bored in it to hold chucks and collets. The latter type of bench is also convenient for holding blueprints out of the way yet handy for reference—J. C. M.



Doubled picture wire in old rubber air hose is a good carrying handle.

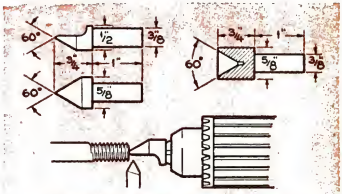
**STORED IN A PORTABLE TANK,** compressed air can be carried with you to a job. The tank is also useful for such specialized work as operating an artist's air brush. It may be filled from your own compressor or at a service station, garage, or commercial shop. Any tank that is sufficiently strong to be safe and is not too heavy for easy carrying may be used. If you don't know its safe pressure, ask a boiler maker to give it a hydrostatic test to pressures well above those you will employ. The tank shown is a stainless-steel breathing-oxygen tank of the type used in military planes. It weighs about 18 lb. and has a volume of 2,200 cu. in.

The tank was obtained with a fitting that had both an inlet and outlet valve. A hand-operated petcock was substituted for the outlet valve and a plate attached to the side to keep the tank from rolling. The inlet valve should be the kind used in auto tubes. Install a reliable pressure gauge as a safety measure.—W. E. B.

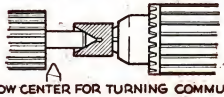
**INEXPENSIVE COLLETS** and a hollow taper-shank holder can be made on your own lathe, will hold round stock accurately, and will allow you to feed stock in through the spindle. Turn and fit the taper on unhardened tool, machine, or cold-rolled steel, insert in the spindle, and drill and bore for a push fit for 1" steel collets as below.

Square the collet stock to 1½" lengths in the three-jaw chuck. Then file 5/16" clamping flats on each. Clamp in the holder with the setscrews, and drill, bore, and ream the holes that are to hold the work.

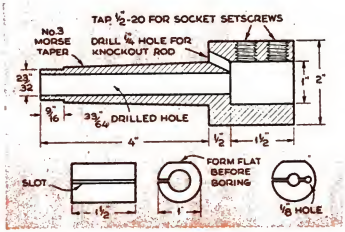
Slit one side of each with a hacksaw and mark the outboard end. For the smaller sizes, make a supplementary hole and slit. When a collet wears, put a strip of soft steel in the slit to prevent compression and rebore larger.—JOHN A. BLAKER.




OFFSET CENTER USED IN THREADING SMALL WORK



HOLLOW CENTER FOR TURNING COMMUTATOR




**OFFSET AND HOLLOW CENTERS** held in a drill chuck in the tailstock of the lathe will save time in turning special small jobs. They can be machined from tool-steel bar stock in one chucking, hardened, and then ground if that is desired. An offset center like the one shown above provides more working room and clearance for threading small work or facing between centers. A hollow center is useful for supporting small shafts or pins, as when truing up a small commutator.—R. M. DYKE.

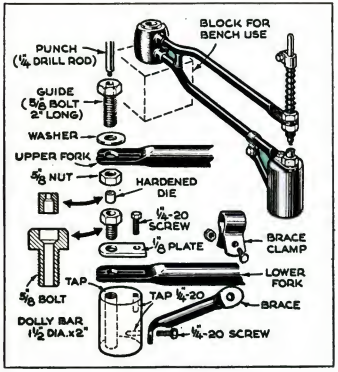
# LIGHT PUNCH PRESS from a BICYCLE FORK

THIS little punch press, made from a rear fork of a bicycle, can be used on the bench or held by hand as the work may require. It can easily put 1/8" holes in mild steel or brass up to 3/32" thick. When it is used on the bench, a block is slipped under the crank-housing end, and a block may likewise be put under the dolly bar for additional support on large-diameter work.

A light spring automatically retrieves the punch from each hole. It is held against a discarded auto throttle-rod clamp that is clamped on the punch over a split brass bushing. Be sure not to use a stiff spring, for it may bend the forked frame.

Punches up to 1/4" in diameter can be made up of 1/4" drill rod for use on light stock, and a hardened die insert may be made for each size. The inserts can be dispensed with, if desired, and the die formed in the bolt head if it is tool steel or can be casehardened. When three or more dies are needed, however, the inserts will save time.

Cut the horizontal fork from an old bicycle frame and file notches near the end of the axle slots for the 5/8" bolts. Drill through the guide bolt, making a sliding fit for the drill-rod punch, and assemble on the upper prong, as shown. Then drill the dolly bar and plate, as indicated, and assemble on the lower prong with a brace and clamp. Bend the prongs to align them.—R. S. MACNEILL.




## Jig Holds Up Insulation Bats for Installation Between Studs

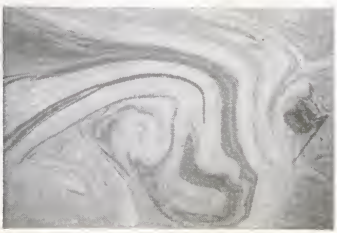
NO HELPER will be needed to hold rock-wool or other insulation bats in place while you nail them to the studs in an attic wall or roof if you use a jig like that shown at left. Grind the ends of three pieces of strap iron to a point and bend each 90 deg. in two places so the point can be pulled into the outer sides of the studs. Nail or screw two of the straps near the ends of a length of board and pivot the third on a fourth strap-iron piece which in turn is pivoted on the board. A heavy spring between the free end of this fourth piece and one of the fixed arms provides the required tension.—LYELL J. MOORE.

# CAN YOU BEAT THESE PICTURES?

*We will pay $5 for any photo used on this page. Write your name and address on each print. Enclose a stamped, self-addressed envelope and the negative, if it is available, and send your contribution to the Curious Photos Editor.*

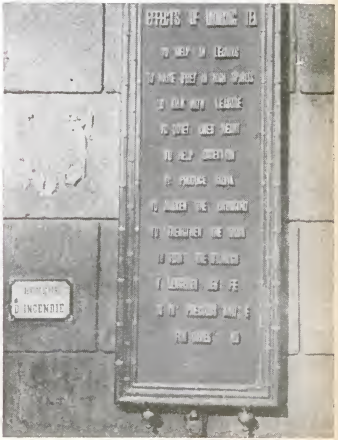
**CROCHETING BY NATURE.** This view of a fence enclosing a chicken yard was taken after a moist snow when every particle clung to the entwined wire. Nature in a domestic mood was caught by Mrs. Marie Lisec, of Omaha, Neb., when she brought her camera into play in her back yard.

**AND NATURE'S MARBLE CAKE.** Would you be able to tell what this curious pattern really is? It is foam on water flowing in and out of an inlet at the edge of a river. J. Q. Womble, of El Dorado, Ark., recognized the possibilities and snapped the interesting pattern from above.



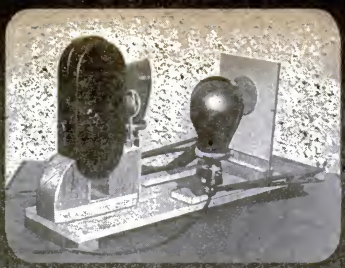
**TIRED, BUT IT HOLDS ITS HEAD UP.** Many trucks have skidded on slippery streets, but this one at Cedar Rapids, Iowa, turned over on its side and pushed its tractor and cab straight up into the air. Luck must have skidded along with it, for the driver was able to climb out from behind the wheel after the accident, dust himself off, and walk to a phone to call a wrecker.

**GOOD ADVICE FROM THE CHINESE.** The sign shown in the photo below hangs outside a tea shop in Tientsin, China. Its recitation of the effects of drinking tea will be a revelation, no doubt, to a good many constant users. N. Mihailoff, who lives in Tientsin, was so intrigued by the sign that he photographed it. In submitting the picture he failed to say whether he himself was a patron of the shop.



# trick Titler

## adds Fillip to Home Movies



If a picture is worth taking, it's worth titling. With a compact little titler like this, the task of dressing up film footage is greatly simplified.

By SIDNEY POTT

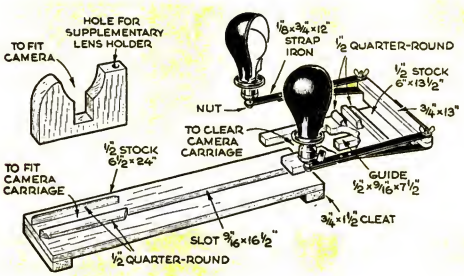
IT'S generally recognized that showing untitled home movies is a sure way of giving your friends that drowsy feeling. Interminable scenes of little Wilbur's first steps, mingled with equally tedious footage of Aunt Beulah smelling the dahlias, represent a parlor ordeal that few friends will take twice. With this compact wooden titler, however, it's easy to turn out a batch of your own individualized titles in short order.

Suited to any ordinary home-movie camera, the device permits you to standardize on lighting and hence on exposure—thus eliminating one variable likely to cause trouble. Interchangeable boards afford title effects that range from the straightforward to the tricky. You will need only the simplest woodworking facilities to build the device.

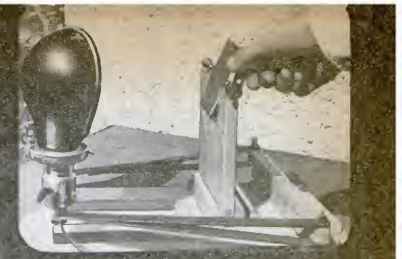
The first step is to provide a means for taking sharply focused pictures at close range. One way is to obtain a supplementary lens that will fit over the regular one. On some cameras, the same result can be secured by extending the regular lens outward a short distance, using an extra lens mount or tube. A third method, which was used by the writer, is to buy some inexpensive spectacle lenses and determine by experiment the lens and distance that give the requisite effect. Sharpness of focus can be checked by using a magnifying glass to study the image formed on a small piece of ground glass placed in the camera gate. I mounted my supplementary lens on a dowel that fits in a hole in the wooden camera support.

A base, a camera carriage, and a titleboard carrier are required, the latter two sliding on the base. Strap-iron brackets support the two metal-shaded lamps. The camera carriage is a block of wood jigsawed to the outline of the camera to be used. If the lens of the camera is not on its vertical centerline, the two quarter-round guides for the carriage should be offset to center the lens on the titler base.

Title boards either ¼" or ½" thick may be accommodated in the slots formed by two other lengths of quarter-round with an intervening spacer strip. The flip-over board, useful for introductory or long titles, is made

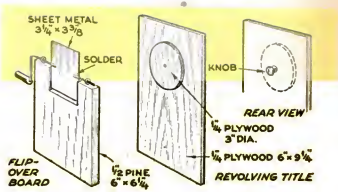


The wooden block that serves as a camera carriage can be modified to receive any home-movie camera. Two pieces of quarter-round act as guides for it.

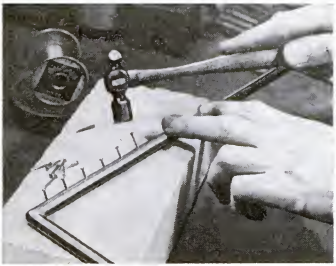


The flip-over board is controlled by a crank. Note that the light-to-board distance does not change, whatever the distance between the board and lens.

with a pivoted sheet-metal rectangle the size of the area covered by the lens. A drum-type variation may also be devised. The revolving title board is used in this way: Paste a title on the disk, turn it upside down, photograph it for normal reading time, and then spin the disk from the back. Splice in the finished film with the whirling section first. The effect on the screen will be a jumbled, circular blur that stops to spell out the desired title.




## Rectangle of Tubing Is Rack for Processing Home-Movie Titles



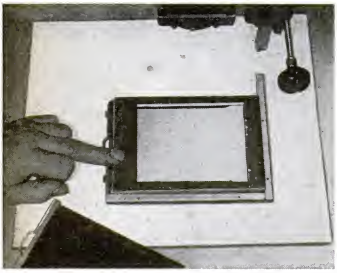
DIMENSIONED so that it will lie in a standard developing tray, a rectangular frame with a row of pins across each end makes a handy rack for developing titles and other short lengths of movie film. While the frame may be made of wood waterproofed with lacquer, nonrusting metal (other than aluminum) is preferable. The one shown uses ⅝" o.d. brass tubing; it fits an 11" by 14" tray and holds about 38' of 16-mm. film.

Bevel the ends of the tubing at 45 deg. and solder the frame together, making tight joints so that solutions won't get inside. Silver solder makes a better job, though soft solder will do. The spacers are brass escutcheon pins, driven into drilled holes a bit smaller than the pins, with a little solder run around each. The heads are cut off and the ends well rounded after driving. The pins may extend straight out, but winding is easier if they project at an angle of 45 deg. If the frame does not rest on the sloping sides of the tray but instead goes to the bottom, four more pins can be located underneath to elevate it slightly.

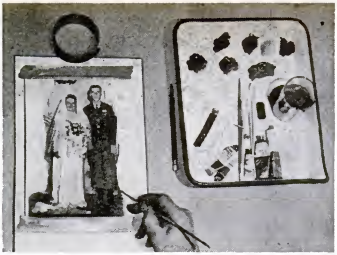
If you wish to run an axle through the rack so it can be rotated for winding film, drill a hole through each side and solder in short tubular pieces. The axle may be a length of ⅛" rod.—W. E. B.

# PHOTO IDEAS

**MAKING TRANSPARENCIES** in the darkroom, for black-and-whites from Kodachromes or other purposes, is facilitated with the system below. Fasten two cleats to a board, and load a cut-film holder with white paper on one side and film on the other. Move the board to position the image and focus on the paper. Then invert the holder, draw the slide, and expose.—I. G.



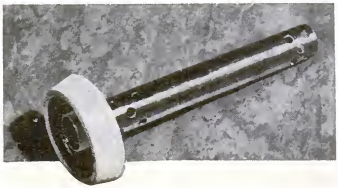
**DUST IS THE ENEMY** of good enlargements, as any photographer who has spent hours spotting prints will testify. A good way to minimize the problem is to shroud the enlarger in a linen bag, uncovering it only for use. A laundered, lintfree sugar or flour bag is also satisfactory.—H. LEEPER.



**A HANDY PALETTE** for tinting enthusiasts and retouchers is a standard 8″ by 10″ tray. The enamel finish is smooth and easily cleaned; tubes and brushes or swabs can be conveniently accommodated; and an accidental upset of a wash-water glass will not mess up the table.—IVAN GROSVENOR.

**SPLASHING** wash water onto the floor got me into domestic difficulties whenever I developed films in the kitchen. To hold my tank up near the faucet, I made a supporting bracket out of 3/16″ brazing rod, soldering the joints. A secondary advantage, I find, is that the tank thermometer is easier to read at this height.—ROBERT BUTTS.

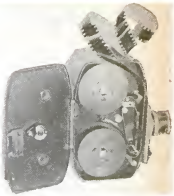
**SINK WASHING** of prints is a pleasure with the drain plug below. A 6″ length of ¾″ brass tube has eight or ten ⅛″ holes drilled around its top and about twice as many near the bottom. A hole is cut through the center of the rubber plug to take the tube snugly. The lower holes let out the heavier, hypo-laden water at a rate determined by how far in the plug the tube is.—W. T.



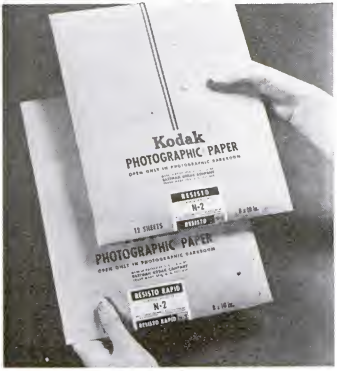
# NEW PHOTO EQUIPMENT

With a sharp-cutting ½" f/2.8 lens, the Bolex L-8 goes in for simplicity. There are no trick gadgets to confuse the amateur.

In loading, one end of the film is put on the take-up spool, and both spools are then inserted. No looping is necessary.

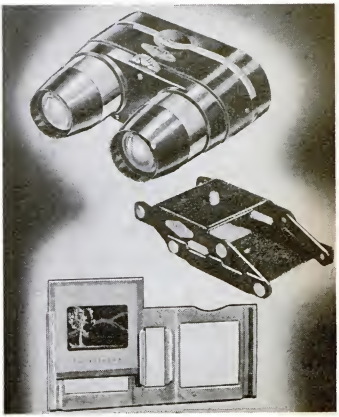


**CONSTANT SPRING TENSION** in the new American Bolex L-8 home-movie camera puts the last frame of film through the lens aperture at the same speed as the first and excludes lags and speed-ups. Complete passage of 25′ of film takes just four windings. A telescopic view finder gives a bright image of the scene, and an indicator appears in the finder when the end of the spool nears so the user won't keep shooting after the film runs out. The film aperture can be removed for cleaning.

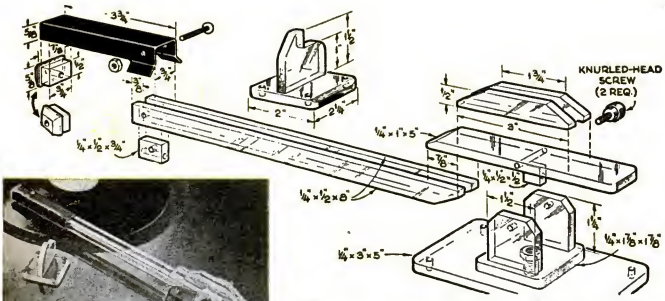



**TWO NEW PAPERS** that dry thoroughly in an extremely short time are announced by the Eastman Kodak Company. They have an almost waterproof, acetate-impregnated base that sheds water. Shrinkage and swelling during processing and drying have been reduced to a low percentage.

**COLOR CORRECTION** even at full aperture is a feature of a new enlarging lens, the Apos Colorstigmat. Especially adapted for color work, the lens is made by the American Precision Optical Systems, of Newark, N. J., in 90 mm., f/4.5, with a 127-mm., f/5.6 lens soon to be ready. Its resolving power is 2,000 lines per inch for black and white and 1,000 lines for color work.



**TWIN TRANSPARENCIES** for stereoscopic viewing come easier with the aid of the new Radex parallel (center at right) mounted between the camera and tripod to permit shifting between shootings. The Radex Stereo Company, of Los Angeles, also is making a new binocular-shaped aluminum viewer and an aluminum slide holder.

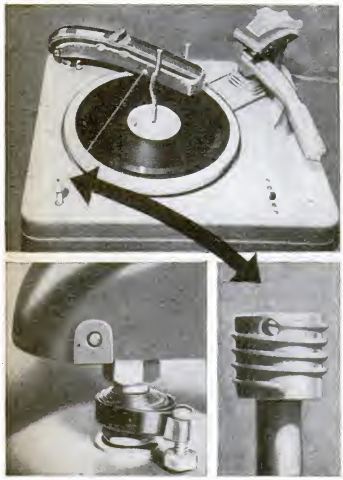


## Phonograph Pickup Arm of Plastic Is Handsome and Light in Weight

HIGH-QUALITY reproduction and modern design are combined in this pickup made from a light-pressure crystal replacement cartridge and a few pieces of ¼" clear plastic, which may be scraps.

The pieces were cut as shown, the edges sanded to a smooth, frosty finish, and joined with plastic cement. Thin aluminum was shaped as shown for the cartridge housing, and a shielded wire run back along the channel of the arm through a length of ¼" pipe nipple at the base. The nipple is a tight fit in the base and a free fit in the swivel bracket, while the knurled screws are a snug fit in the bracket and a free one in the arm for easy action.—ROBERT WOOLFOLK.

## Recording-Disk Grooving Rig Uses Electric-Clock Motor



WITH pregrooved recording disks hard to find, many home-recording enthusiasts have been forced to use expensive cutting heads in order to make impressions on ungrooved blanks.

Having assembled all the equipment except the cutter, however, I found that the rig shown at the left gave excellent service as a pregroover. The only unusual piece of equipment involved is a 1-r.p.m. electric-clock motor. Mounting the motor inside the cabinet, I fitted the vertically projecting shaft with a small section of ½" bolt. The bolt acts as a winding drum for a length of No. 30 wire fastened to the recording arm about two thirds of the way from the pivot. As the clock motor turns, the needle is pulled across the record. A light coil spring placed around the pivot, as shown at the lower left, provides the slight tension needed to keep the wire tight between pickup and drum.

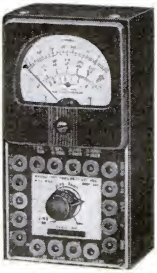
For proper operation, the drum must rotate at a constant speed and be completely free of wobble. Spacing of the grooves can be varied to some extent by shifting the connecting wire closer to, or further from, the recording-arm pivot. Using this setup, I get about 75 lines per inch. The smaller the drum, the more lines.—STEFFEN H. SORENSEN.

# NEWS in ELECTRONICS

**JUKE-BOX JANGLES** may become a thing of the past if this new electronic phonograph takes over the music-making job at taverns and restaurants. A product of the Aireon Mfg. Corp., of Kansas City, Kan., this coin-operated phonograph automatically adjusts its output to the noise of the room in which it is playing. Its volume is controlled by a microphone which "listens" to the audience, and acts to keep the music at just a pleasantly audible level. At left, Jo Stafford, popular singer, smiles her approval of the new device.

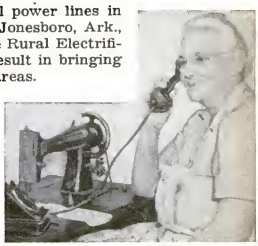
**DIRECT MEASUREMENT** of the output of electronic equipment is made possible by six newly developed power-measurement lamps. Manufactured by Sylvania Electric Products, Inc., of Emporium, Pa., the lamps are said to measure outputs of .05 to 25 watts at frequencies up to 900 mc.

**POCKET-SIZE** testers are always popular, especially with servicemen who carry their equipment to the job. This instrument, made by Radio City Products Co., New York, weighs only 1¾ lb. complete, and features six multi-range testers for A. C., D. C., and output volts, milliamperes, ohms, and decibels. The case measures 2" x 3" x 6".



**ELECTRONIC "SMELLERS,"** are now used to detect the presence of harmful mercury vapor. Sensitive enough to detect one part of mercury vapor in 100 million parts of air, this equipment, designed by General Electric, helps keep the concentration of the vapor from rising above the safety level. Its operation is based on the fact that ultra-violet light is scattered when it passes through atmosphere containing the toxic fumes.

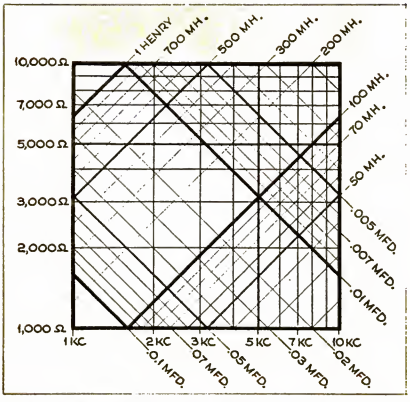
**VOICES GO HITCHHIKING** over rural power lines in an experimental system installed near Jonesboro, Ark., by Bell Telephone Laboratories and the Rural Electrification Administration. The test may result in bringing phone service to out-of-the-way rural areas.



Mrs. Carl Robbins puts through one of the first calls to go over the new power-line phones, while William Hickox, left, completes an installation. The equipment in the box produces a high-frequency carrier current.

# Filters... *radio's most*

## How ingenious combinations of censors in your receiver to




A reactance-frequency graph, of which this is a section, gives direct values in ohms for any frequency up to 1,000 kilocycles.

By GEORGE O. SMITH

FILTERS are electronic circuits that have frequency selectivity. At the will of the designer, they can be made to pass or block frequencies below, above, between, or around certain specified limits. The names of the four major types are self-explanatory; they are low-pass, high-pass, band-pass, and band-elimination filters. Taken together they make possible two important things: the first is radio reception; the second is *good* radio reception.

The ability of filters to discriminate against certain frequencies is due to the fact that the resistance of capacitors and inductors to alternating-current changes with frequency. Alternating-current resistance is called *reactance,* and is symbolized by the letter X. Like direct-current (or pure) resistance, it is measured in ohms.

In the case of a choke coil labeled, say, 30 henries, 200 ohms, the 200 ohms stands for the resistance of the wire that is wound on the coil. This is a constant minimum, regardless of frequency; it would still measure 200 ohms if a D. C. potential were applied, or if the wire were stretched out straight. Reactance is another matter. It increases as frequency increases. In addition to the resistance of the wire, a 30-henry choke has a reactance of about 11,300 ohms at 60 cycles. At 600 cycles, the reactance has grown to 113,000 ohms. The way in which the reactance of a coil varies with frequency is expressed by the formula: $X_L = 2\pi f L$, where $X_L$ stands for inductive reactance, $2\pi$ is the constant 6.28, f equals frequency in cycles per second, and L represents inductance in henries.

A good capacitor, on the other hand, has infinite resistance to direct current, but will pass alternating current more or less readily, depending on frequency. Unlike the choke coil, the reactance of a capacitor goes down as the frequency goes up. In mathematical terms, $X_C = \frac{1}{2\pi f C}$. Here, $X_C$ stands for capacitive reactance, and C is a measure of capacity in farads. A .01-microfarad capacitor would have a reactance of about 265,000 ohms at 60 cycles, but only 26,500 ohms at 600 cycles. The total opposition that inductive reactance, capacitive reactance, and resistance offer to the flow of an electric current is called *impedance.*

Between them, capacitors and inductors can hold any alternating current at their mercy. Used in various combinations—series, parallel, and series-parallel—coils and condensers serve varied functions in radio transmission and reception. They polish off rectified A. C. so as to provide a smooth D. C. power supply; in the form of tuning circuits they enable you to select a station at the twist of a condenser.

This article makes no attempt to deal with all filtering actions. While filters are integral in the basic radio circuit, they may also be added to existing amplifiers as tone-corrective devices. One of the simplest types is that shown at the right. This is a form of high-pass filter, and it operates in precisely the same way as a voltage divider, except that the resistance of one leg automatically varies with frequency. Let us say that the components of the circuit are

# *important networks*

**resistors and condensers can be made to act as electronic screen out unwanted frequencies or boost fading ones.**

a 50,000-ohm resistor, and a .01-mfd. capacitor. Then at 320 cycles, Xc equals 50,000 ohms, and the output voltage at the tap between the two elements is one half the input across the divider. This is just what you'd get if both R and Xc were 50,000-ohm resistors. But at 640 cycles, Xc has fallen to 25,000 ohms, which gives a voltage division of one-to-two. The output is then two thirds of the input.

Now, if both 320 and 640-cycle signals are put into the circuit simultaneously at equal voltages, two thirds of the 640-cycle signal will come through, but only half of the 320-cycle note. Conversely, if the 320-cycle input were, say, 12 volts, and the 640-cycle signal were 9 volts, both signals would come out as 6 volts A. C.

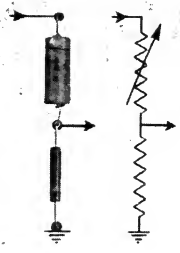
The first effect is useful in boosting high frequencies, while the second helps to level off the response of an amplifier that favors the lows. Carrying the calculation higher and lower than the figures given will demonstrate the high-pass effect of the filter. The graph at the bottom of this page shows the output response of a typical high-pass, tone-corrective filter. At 100 cycles the output may be about one fourth of the input, while at 10,000 cycles almost the entire voltage drop is across the resistor.

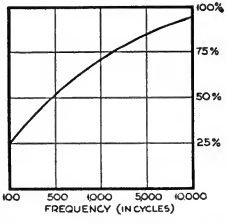
In order to design a resistor-condenser filter to suit your own needs, you will have to determine the reactance of any given condenser within the limiting frequencies. These values may be obtained either by calculation, or through the use of a reactance-frequency graph which can be purchased at any drafting-supply house. The figure on page 190 is one small segment of such a graph, twice enlarged. To find the reactance of any condenser, locate the condenser's capacity along the right-hand edge of the chart. (In the section reproduced, capacities are carried around to the bottom of the sheet.) Follow the sloping line up until it intersects the vertical line that represents, say, the lowest frequency you are interested in filtering. Where these two lines cross, read straight over to the left-hand margin where capacitive reactance is indicated directly in ohms.

From this chart, get the reactance of the condenser for a number of frequencies in the passband of your filter. Assuming a standard load resistance, you can then figure how the voltage will divide for each frequency, and draw a graph representing the output of this particular filter. Percentage of output is obtained by dividing the sum of reactance and resistance into the resistance. If the resulting curve doesn't suit your needs, try another capacity.

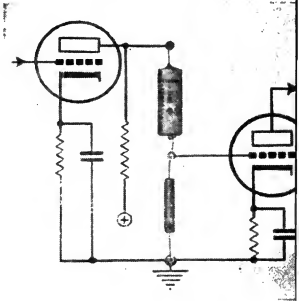
In constructing a filter, remember that a large capacitor and a large resistor give quite different results than a small capacitor and a small resistor. For example, a .2-mfd.

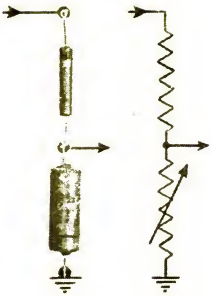
If your receiver tends to cut off or distort the high notes, this tone-corrective filter may be just what it needs. It acts like a voltage divider in which the ratio of output to imput rises with frequency.



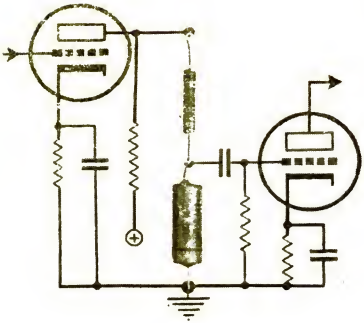



Signal-attenuation curve of a typical resistance-capacity high-pass filter.





Tapping the output voltage off the capacitor will tend to favor the low notes.



Used between amplifier stages, this type of filter requires an extra condenser-resistor arrangement in the coupling circuit.

condenser and a 2-megohm resistor show less than 1 percent response difference between 80 and 8,000 cycles, while .001 mfd. and 20,000 ohms will cause about 40 percent difference in the same range.

This type of filter may be connected between the audio stages of an average amplifier as shown in the hookup schematic on page 191. While calculated values give you a good starting point, the final test of any filter is in its effect on the entire amplifier. Because of distributed effects, calculated values are at best approximate, and it may be necessary to juggle values a little until you get a result that is pleasing to the ear. A voltmeter placed across the amplifier output will help you to check the real effect of a filter. Used in conjunction with an audio-frequency generator, or a frequency-test record, the voltmeter will show how output voltage varies as the input frequency is changed.

While resistor-condenser combinations are often favored for tone correction in audio circuits, there are times when a more level response is desirable. Let us say, for example, that you want to give equal emphasis to all notes between 10 and 1,000 cycles. The response curve shown on the previous page would then not be satisfactory. At 1,000 cycles, this filter has almost three times the output it has at 100 cycles, whereas the graph we now want should be level between the two extremes of our passband.

To obtain this effect it is necessary to replace the resistor with a choke coil, thus giving your voltage divider two variable arms instead of one. When the reactance of one arm increases, that of the other decreases correspondingly.

The use of inductance-capacity filters, however, involves a number of other critical considerations which are outside the scope of this article. Getting back to our first circuit, let's see what happens when we make a few changes.

Reversing the positions of the filter components produces, reasonably enough, an opposite effect. The illustrations above show how this is done to produce a low-pass filter that will attenuate the higher frequencies. In this case the output voltage is tapped off the variable leg of the divider. As frequency goes up, the reactance of the capacitor decreases, giving a lower voltage drop for the higher frequencies.

Using a filter of this type between amplifier stages requires certain precautions that are not needed with the high-pass unit. By themselves, the filter components would put part of the high plate voltage on the grid, and the condenser would block the grid return to ground. The schematic diagram above shows the additional circuit elements that must be used when this kind of low-pass filter is inserted between stages. In this hookup, the filtering is done between the plate connection and ground, and the grid is coupled to the filter terminal through a condenser-resistor arrangement. This, however, constitutes another high-pass filter; if the components of both sets were alike, they would merely nullify each other.

To offset this possibility, the coupling components are made large, thus reducing

their frequency selectivity, and allowing the desired filter to do most of the frequency selection. The coupling condenser for this circuit should be about .1 mfd., and the grid resistor about 2 megohms.

Among the "built-in" defects of many existing amplifiers is an auditory effect known as "loss of bass." Most often this is noted when the volume control is turned to a low position. A tone-corrective filter that often succeeds in eliminating this fault consists of a tapped volume control with a condenser connected between the tap and ground. When the volume control is turned down near the tap or below, the condenser causes it to act as a type of low-pass filter. As volume decreases, the low notes are increasingly favored, thus compensating for the loss of bass.

To prevent overemphasis of the bass, a limiting resistor should be used in series with the condenser from tap to ground, as shown at the left, below. At high frequencies the capacitive reactance may drop to just a few ohms, yet the series resistor maintains the total shunting effect above the level of its own resistance. At low frequencies, the higher capacitive reactance adds its ohmage to that of the resistor, raising the shunting effect.

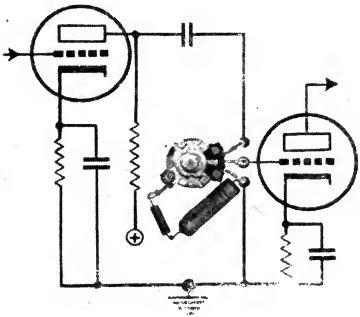
In order to reverse this effect, the limit-resistor should be connected in parallel with the condenser, as shown at the lower right. Below the so-called "cross-over frequency" —that frequency where the capacitive reactance equals the pure resistance—the incoming signal sees mainly the pure resistance shunting the line. Above this frequency, the line is shunted by the resistor and the lowered reactance in parallel.

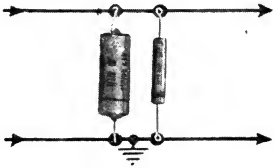
Connected in series, the impedance of this filter tends to level off to the limiting resistance above the cross-over frequency, while in the parallel hookup the total impedance is level for frequencies below the cross-over level, and the impedance drops as the frequency rises above the critical value.

As before, the final test of these filters is in the listening. Using a .01-mfd. condenser and a 30,000-ohm resistor as a starter, this tone compensator can be adjusted to suit your taste. Set the volume-control arm to the point that gives the lowest ohmmeter reading between tap and arm, and leave it at that value while making changes.

Some increase in high-frequency response can be obtained with this filter by connecting a small condenser—say 50 mmf. to 250 mmf. —between the top of the control and the tap. The over-all response will then be low in the middle-frequency ranges, and have broad peaks at both the low and the high ends. This type of response curve is generally considered to be the most pleasing.

The thing to remember about resistance-capacity filters is that the use of a frequency-selective element (the capacitor), in conjunction with a nonselective element will produce all manner of curves in the audio response of an amplifier. Whether high or low frequencies will be passed or blocked depends upon the position of the components, while the range of any filter is governed by the size of the parts. Doubling or adding filter after filter will steepen the response curve. In one combination or another, filters will permit you to do just about anything you want with just about any alternating-current signal.

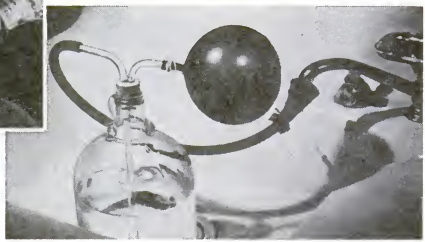




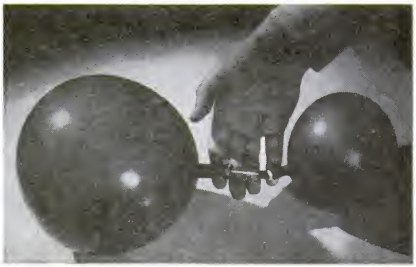
If turning the volume control low produces a "loss of bass" in your receiver, inserting a condenser between volume-control tap and ground may give the failing low notes a boost.

# HOME EXPERIMENTS SCIENTIFIC

**ILLUMINATING GAS** may be forced into a balloon in order to give it buoyancy. *But keep such balloons away from fire, for this gas is highly explosive.* Fill a 1-gal. bottle with water, insert through the stopper two glass tubes (one long enough to reach the bottom), and run rubber tubing from the gas supply to the short tube and from the outlet to a pan below. When the gas is turned on, pressure starts water flowing in a siphon action. After the bottle is partly filled with gas, attach the outlet tube to a faucet, as below, and quickly tie a balloon on the short glass tube. Turn on the water and the resulting pressure in the bottle drives the gas into the balloon.



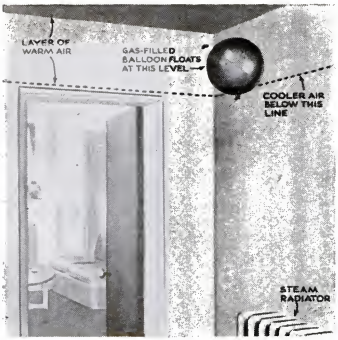
**BALLOONS OF DIFFERENT SIZE** react in an unexpected way when connected by a tube as below. You might think the larger would blow up the smaller until both were of equal size. But the reverse happens. Air rushes from the smaller to the larger balloon, inflating it still more. Why? Because the pressure per square inch exerted by the rubber is greater in the smaller balloon, there being less surface for this force to press on.



**DRY ICE,** which is solid carbon dioxide, creates tremendous pressure when it changes into a gas. This may be used to expand a balloon. Fold a chunk in a cloth *(never touch dry ice with the hands),* break it into small pieces, drop several with a spoon into a bottle partly filled with water, and tie the balloon on the neck.

# TRICKS with TOY BALLOONS

**AIR UNDER PRESSURE** increases in weight. You can demonstrate this by inflating two balloons to equal size, tying them to the ends of a stiff wire about a foot long, and balancing the wire carefully at the center. Let the air out of one and the other will sink. Being under extra pressure, the air in the inflated balloon is denser—and hence heavier—than the air of the free atmosphere.



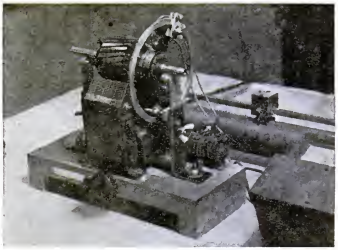

**IN A HEATED ROOM** a gas-filled balloon that has been weighted with just enough paper clips or cardboard so that it barely rises will give the performance illustrated above. It will rise to just about the height of the doorways and remain suspended there in midair. This is because the layer of heated air near the ceiling, being lighter, is less buoyant than the cooler air below.

**SOUND WAVES** that are passed through a lens-shaped area of a gas that is heavier than air will come to a focus much the same as light waves passing through a glass lens. You can demonstrate this with the balloon that was filled with carbon dioxide gas in an accompanying experiment. Hold the balloon between your ear and a ticking watch. By maneuvering the balloon you will find a spot in which the ticks sound considerably louder than they do when the balloon is removed.

**PLACE A BALLOON** in the airstream of a fan tilted as below. Instead of straight down, the balloon falls diagonally— into the breeze that is trying to blow it away. This is explained by Bernoulli's principle. Air flowing rapidly around the balloon is at a lower pressure than the still air at each side of the stream. When the balloon tries to fall out of the stream, the greater pressure outside forces it back.

# Growler Accessories Help to Check Armatures

ARMATURES are usually tested for faults in devices called growlers, most of which are designed for the armature to rest on the poles. Test prods on the commutator segments and a phone receiver or low-reading voltmeter take bar-to-bar values, and it is not always easy to get these readings in a really accurate manner. But with the armature rotated on ball bearings (Fig. 1) with a small air gap between the poles, a steel ring (Fig. 2) attached to the upper section of the opposite sliding-shaft support, and an adjustable contact block (Fig. 3) arranged on the ring to stay fixed on any desired point of the commutator, the true condition of the windings can be quickly ascertained.

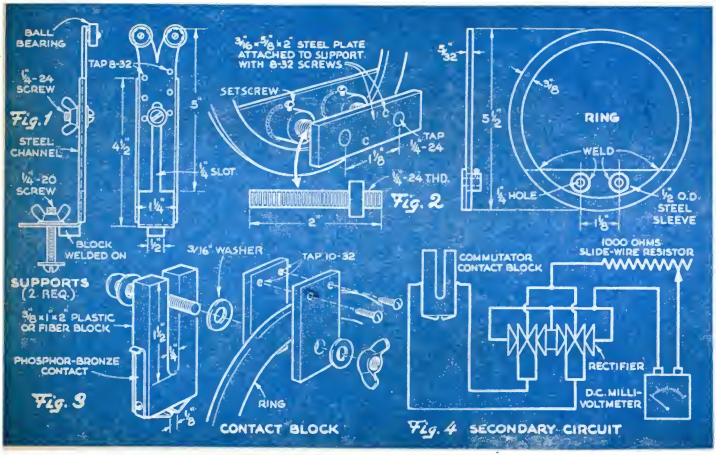


Make the hardwood base with a ½" wide slot so the bracket supports will fit various lengths of armature shaft. Other parts are steel. Dimensions may be changed to suit the growler used. The contact block is made of plastic or hard fiber, and it has two phosphor-bronze contact points fitted at the lower end. By means of a clamp and wing nut, this block can be placed and locked anywhere on the ring. The slot in the center permits raising or lowering of the contacts to meet commutators of different diameters.

For the first test for shorts, the armature is placed in position between poles and the shaft supports are adjusted so the core clears the growler points with a small air gap between—the smaller the gap, the higher the readings because of the greater magnetic flux. The contact block is not used. Bar-to-bar testing is done with the block adjusted to make a firm contact between the points and a pair of adjacent segments.

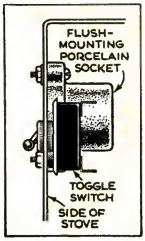
A good setup for making these tests is shown in Fig. 4. The A.C. picked up from the commutator is fed to a small dry-disk rectifier connected to give full-wave rectification, and readings are made on a sensitive D.C. millivoltmeter having a 1,000-ohm slide-wire resistance in series for adjustment of the readings so they will come near the center of the scale. This equipment is also shown in the photo above.

Most of the usual armature troubles, except reverse winding which should, of course, be checked with a wattmeter, can be found with this instrument. Readings should be taken all around the commutator, and they should be consistent or equal sequence all around.—HAROLD P. STRAND.



## Lamp Brightens Dark Stove Top

IF YOU don't feel at home on the range because there isn't light enough to show what's cooking, it's easy to brighten your outlook. You'll need to drill four holes in the side panel of the stove back—two for mounting a socket, one for a 110-volt toggle switch, and the fourth, fitted with a bakelite bushing, for the cord. This should be asbestos covered, as it's exposed to considerable heat. Flip the switch and you can see that the carrots *are* about to burn, and the steak *is* done to a T.—H. D. SMITH.

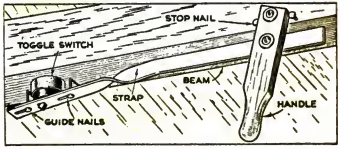



## Levers Reduce Shock Hazard

COMMON toggle switches shouldn't be used in damp locations, as in the cellar or laundry, especially where wet hands may result in dangerous shocks. If you must use such a switch, rig it as at the right. A dowel, notched for the toggle and guided in screw eyes, can be used instead of the metal strap.

## Pipestem Light Frees the Hands

WISHING you were an octopus when you need both hands to work with and a third one for a flashlight won't help, but this homemade rig may. Solder a radio pilot-light socket, or one from a Christmas-tree lamp set, into the cover of a shoe-polish can. Then solder a nail to the bulb terminal and attach two leads. Push the nail into a pipestem, cementing it in if necessary. For current, solder series jumpers to the requisite number of flashlight cells and tape them together for carrying in a pocket. Small paper or alligator clips, or dress snap fasteners on all leads, facilitate connection.—AL SCOTT.




## LAMP RESISTANCE VALUES [ELECTRICAL]

Common lamp bulbs may serve as resistors in electrical experiments. The table below, supplied by the General Electric Company, lists resistance values of 120-volt lamps when cold, and when 25, 50, 75, and 100 percent of rated voltage is applied. Filaments have much lower resistance cold than hot, and common watt ratings are based on their resistance when white hot. In normal use filaments reach incandescence quickly, and there is only a brief surge of heavier current. Remember this, however, if delicate apparatus that may be damaged by such a surge is used.

In choosing a lamp, calculate the voltage drop across it and find its resistance at that potential in the table. Example: It is desired to connect a low-resistance coil to draw no more than .83 amp. on a 120-volt line. Disregarding coil resistance as negligible, the entire drop will occur across the lamp, which will thus receive 100 percent potential. By Ohm's law, we find that at 120 volts 144 ohms will pass .83 amp. In the last column, 144 ohms is the hot resistance of a 100-watt bulb.

Example: A device rated at 20 volts and .5 amp., and therefore having a resistance of 40 ohms, is to be connected to 120 volts. By calculation a total resistance of 240 ohms is required of which the lamp must represent 200. The drop across the lamp must be 100 volts, which will therefore receive about 83 percent of full voltage. The nearest column is that for 75 percent, and here we find a resistance of 201 ohms for a 60-watt bulb.

| | Approximate resistance in ohms | | | | |
|---|---|---|---|---|---|
| Watts | Cold | 25% | 50% | 75% | 100% |
| 6 | 193 | 1390 | 1837 | 2127 | 2400 |
| 10 | 113 | 822 | 1094 | 1293 | 1440 |
| 15 | 73 | 540 | 722 | 856 | 960 |
| 25 | 42 | 318 | 427 | 509 | 576 |
| 40 | 24½ | 173 | 253 | 299 | 360 |
| 50* | 21 | 141 | 206 | 241 | 288 |
| 60* | 17 | 117 | 171 | 201 | 240 |
| 75 | 12 | 98 | 136 | 154 | 192 |
| 100* | 10 | 77 | 104 | 116 | 144 |
| 150 | 6 | 48 | 69 | 84 | 96 |
| 200 | 4½ | 36 | 51 | 62 | 72 |

* Coiled-coil filaments.

Percentages = % of 120 volts

POPULAR SCIENCE MONTHLY SHOP DATA

# HOW CHEMISTRY

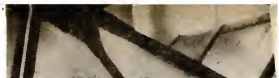
Silver nitrate and potassium bromide are the key chemicals in the emulsion on film and photo-print paper. In crystal form or in separate solutions, they are unaffected by light. At top, purifying silver nitrate in a big Eastman evaporating room.

**What goes on in the emulsion that coats film is shown by simple test-tube experiments.**

By TRACY DIERS

THE film in your camera is thinly coated with one of the most unstable chemicals known to man. Silver bromide is its name, and from the moment of its birth it is kept in a cradle of darkness until in your camera a swift shaft of light seeks it out. The intricate and far-reaching changes brought to silver bromide by that flash of light are in part still secrets of nature. Much of what happens in your camera and in the darkroom is known, however, and can be shown at home with a few chemicals in a test tube.

Dissolve a crystal of silver nitrate in a test tube half full of water, and dissolve a crystal of potassium bromide in another. If you place both test tubes in direct sunlight, nothing will happen. Mix the two together, and immediately a yellow precipi-



# CREATES A PHOTOGRAPH

Yellow silver bromide is formed by mixing solutions of silver nitrate and potassium bromide. Light frees bromine gas and leaves dark silver.

tate of silver bromide falls to the bottom of the tube. Expose this to strong sunlight or to a photoflood bulb, and it will immediately turn purple. This purplish-colored material is chemically pure silver, freed from the bromine it was formerly attached to. You might say that the reaction was this: Silver bromide plus light equals silver plus bromine. The latter goes off as a gas.

Since it isn't practicable to coat films or paper with a lumpy precipitate, we had to invent some method of spreading the chemical evenly and thinly over the surface we wished to sensitize. The answer was to suspend the silver bromide in an emulsion. Dissolve, with gentle heating, 20 grains of household gelatin in a test tube half full of water. Add a pinch of potassium bromide and then pour in a dilute silver nitrate solution. Silver bromide is again formed, but this time it remains evenly suspended.

In photography the action of the silver bromide is speeded and intensified by the use of a developer. Stock developing solutions consist of a developing agent such as pyro or hydroquinone, an alkali such as sodium carbonate or borax, a little potassium bromide as a restrainer, and some sodium sulphite as a preservative. To show how a developer works, put several drops of any stock developer solution in a flask of silver bromide emulsion that has been exposed only briefly, and not sufficiently to turn dark. The emulsion now turns black in a few seconds—much faster than when light does all the work of separating the silver.

On exposed film, you would now see an image consisting of dark areas of metallic silver and light areas of unexposed silver bromide that the developer has not affected. A fixing bath is next needed to keep these light areas from darkening upon subsequent exposure to light, for if they did the entire negative would turn black and the image would be lost. The fixing bath is sodium thiosulphate, the hypo familiar to every photographer.

You can see how it works by dissolving a few small crystals of sodium thiosulphate in water in a test tube and pouring the solution into half a test tube of *unexposed* silver bromide emulsion. Immediately the yellow

Silver bromide alone would not coat film evenly. An emulsion is made by adding gelatin. In it the particles are suspended as in the tube at the far left.

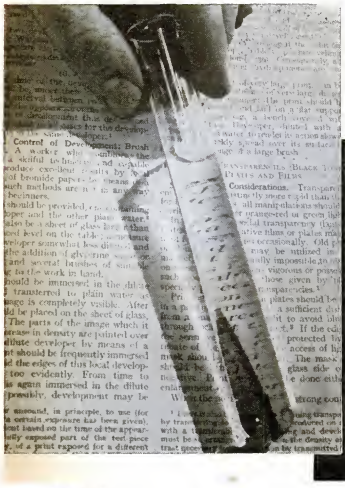
Developing makes more intense the emulsion changes caused by light. A few drops of stock developer in an exposed flask quickly turn the silver black.

suspension disappears, and the tube contains a clear, transparent liquid.

What happens is this. Sodium thiosulphate reacts with silver bromide to form silver thiosulphate, a clear solution; then, if there is plenty of fresh hypo present, the reaction continues, forming complex salts that are dissolved by the remaining hypo.

A simple taste test illustrates the point. Fresh hypo has a salty, bitter taste, and silver sodium thiosulphate is almost as sweet as sugar. Dip a sheet of ordinary writing paper in a solution of 1 oz. of hypo and 4 oz. of water, rinse it in water for a moment, and taste the salty hypo remaining. Then dip a small piece of enlarging paper in the hypo for a few seconds, rinse it quickly, and taste the sweet emulsion side. Return the enlarging paper to the hypo for a few minutes longer, remove and rinse it, and you taste the salty hypo again. Expert photographers avoid stale hypo so that the reaction, or fixing, will be complete and no silver sodium thiosulphate will remain.

Every photographer has taken negatives that were too light or too dense to afford



Fully developed black emulsion in the tube (left) becomes a clear solution when a reducer is added. That's how reducers act on overexposed negatives.

Tasting reveals that too short a bath in hypo, or weak hypo, leaves a sweet salt that in time will stain emulsion. Fresh hypo gets rid of the salt.

good prints. Too light an image may be due to underexposure in the camera, or underdevelopment in the darkroom. A negative of this kind can sometimes be salvaged by *intensification.* Too dark a negative can be improved by *reduction.*

To show the action of a common reducer, first prepare half a test tube of silver bromide emulsion, expose it, develop with a few drops of stock developer, and add four or five drops of glacial acetic acid (the photographer's short stop) to halt development. Then add 6 cc. of hypo solution. To the dark emulsion you now have, slowly add a reducing solution consisting of 25 grains of potassium ferricyanide in 1 oz. of water. Watch the dark silver particles lighten as they are changed into silver ferrocyanide and in that form are dissolved by the hypo. This is the well-known Farmer's reducer.

A common method of intensification is to combine the silver deposits of the negative with some denser metal such as chromium or mercury. To show how a typical intensifier works, first make up the usual emulsion, expose, and develop it as before. Add a few drops of glacial acetic acid short stop. Oddly enough, the first step in intensification is bleaching. Add 20 grains of mercuric chloride to 1 oz. of water and pour in enough of this solution to bleach out completely the black metallic silver, which in the process is converted into white silver chloride.

On a negative, the image seems lost at this step. It is brought back by redevelopment. To your bleached test-tube emulsion, add a little ordinary ammonia water. The emulsion becomes even blacker than it was before; it has been intensified. The new blacker chemical is a very complex salt, silver mercury ammonium chloride.

The process of toning photographs, in which the black areas are converted to sepia or some other color, also may involve bleaching and redevelopment. Prepare the usual small quantity of emulsion and develop it after exposure. Add the acetic acid short stop. Then prepare a small flask of bleaching solution consisting of 110 grains of potassium ferricyanide, 110 grains of potassium bromide, and 2 oz. of water. Also dissolve separately in a test tube 50 grains of sodium sulphide in 2 oz. of water. This is the redeveloper.

Pour some bleaching solution into the developed emulsion. The black silver particles are quickly bleached out into a yellowish substance. The silver first becomes silver ferrocyanide and then silver bromide.

Now pour in some of the redeveloper and at once the emulsion turns brown—in a photo, sepia toning would have resulted. The sodium sulphide in the redeveloper has changed the silver bromide to silver sulphide, the compound that appears as tarnish on silverware, and this is the sepia tone.

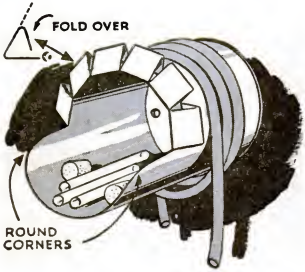
This is the same negative at two stages. Below, it has been underexposed or underdeveloped, and is too thin readily to afford a good, contrasty print.

Here the negative has been put through a process of intensification that makes the image denser by causing the silver deposits to form new compounds.

**CAUSTIC SOLUTIONS** of some strength are likely to make trouble if kept in glass-stoppered bottles; the ground glass joint will "freeze" tightly, rendering it difficult to open the bottle. A rubber stopper is naturally the answer—but if you don't have one handy, cut the finger from a discarded rubber glove, pulling it over the regular stopper.—A. S. LANDRY.

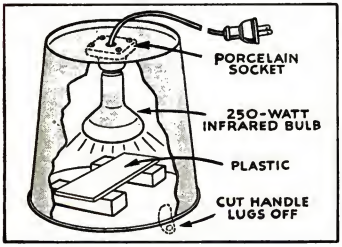
## Tin Can on Lab Wall Holds Rubber Tubing Safely

HELD by two screws into the wall over the bench, a tin can makes a good rack for soft rubber laboratory tubing. Cut a series of tabs on the edge of the can and bend them back to form a retaining lip. The inside of the can affords a convenient place to store pinchcocks, stoppers, and short lengths of glass tubing. Use emery cloth to round off the sharp edges formed when the can is cut.—BOB FLEMING.




## Pail Makes Oven for Plastic

WITH an old 10-qt. pail you can make an electric oven for heating plastic that will take this operation out of the kitchen and into the shop. Cut off the lugs that hold the bail, attach a flush-mounting porcelain socket inside the bottom, and screw in a reflector-type 250-watt heating lamp. You'll find that the average piece of lucite or plexiglas will become limp and ready for shaping in three to five minutes. Watch the time closely, because too much heat will blister the work.—T. GLENN HETRICK.



## Frosted Area Allows Test-Tube Notes

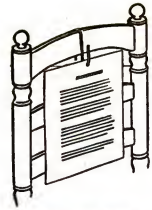
GUMMED labels on test tubes are always coming off, burning, or becoming stained. Because I find it desirable to make notes on test tubes, I frost an area near the top of each tube, using emery cloth or pumice stone. Writing is done with an ordinary pencil, and it can be wiped off with a damp cloth when you wish to make changes.—EUGENE A. REESE.

## Old Waxed Cartons Are Useful

CARDBOARD milk containers and cylindrical ice-cream cartons are usually thrown away when they have served their original purpose. However, if they are rinsed in lukewarm water and dried, they will be found to have numerous uses in the home shop, on the chemical bench, and in the darkroom. Being cheap and disposable, they're especially suited for such jobs as blending paints, mixing plastic glues, and the like.—N. G.

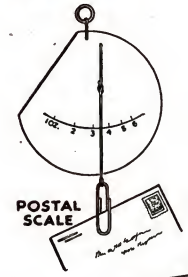
# paper clip

MANY are the uses of the lowly paper clip. Besides the ten ideas shown, you can also make a clip into a hook for working knots, a reamer for clogged mechanical pencils, an axle for a cardboard toy, a "memory ring" to remind the forgetful, a marker to identify keys, and a holder for a test-tube bud vase.—L. LOTHROP.



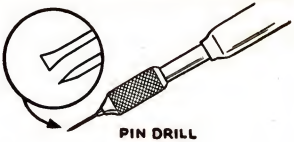
COPY HOLDER

BUTTON RING



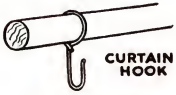

POSTAL SCALE

POISON WARNING



PIN DRILL

NONROLLING PENCIL

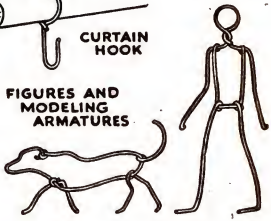


CURTAIN HOOK

DRIPPER

LOCK PICK

FIGURES AND MODELING ARMATURES



## Snap Fastener Keeps Typewriter Eraser Where You Want It

TYPEWRITER erasers, if free to roam, are as elusive as a handful of quicksilver. Chaining them to the table with rubber bands or string will break them of the runaway habit, but the string involves its own complications. I solved the problem by obtaining a large snap fastener at the dime store, and soldering one part of the fastener to the typewriter and the other to the metallic eraser disk. Now I know where to reach for it.—ANDREW VENA.

When Charles or Wellden Neill sits at the console of their homemade organ in West Orange, N.J., the neighbors never know what to expect. With stops all out, the organ can be heard for blocks.

The two Neill brothers have their attic lined with 1,000 pipes. Charles, shown in these photos, is examining some of the big 10' boss pipes located along the stairway leading to the attic.

# House of a THOUSAND PIPES

TWO hobbies have given Charles and Wellden Neill the unusual organ for which they have installed 1,000 pipes in the attic of their West Orange, N. J., home. Charles is an electrical engineer and, besides helping to build his own organ, likes to install and rebuild organs in churches. Usually he can pick up a few leftover pipes on such a job, and his goal is to add 500 more of them to his and Wellden's collection.

Wellden, recently out of the armed service, is a student at Upsala College in adjacent East Orange. He and Charles play anything from swing to Bach. The neighbors? They're used to it, the brothers say, and besides, they like music.

Pipes for the organ are made of wood and zinc and are both decorated and plain. They were obtained from five churches. Some date back to 1870.

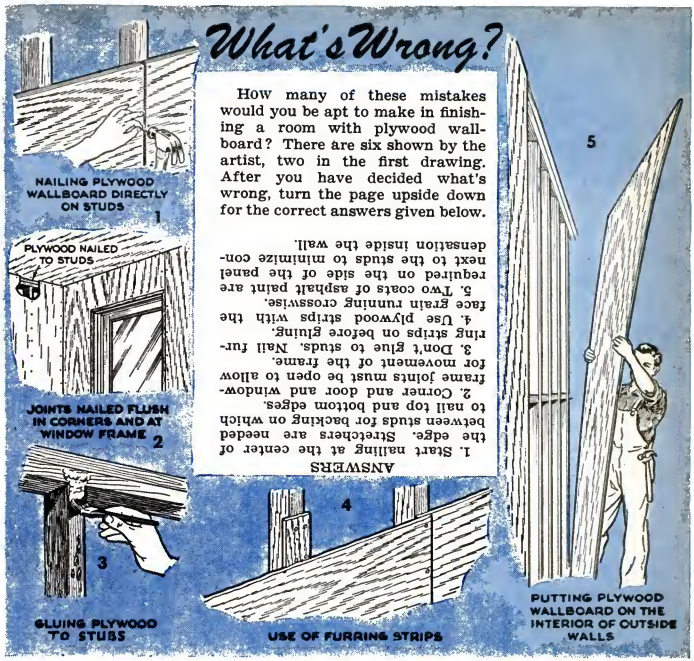
From the big bosses, the pipes range down to the size of a lead pencil. The organ can be played from downstairs or from an attic keyboard.

# What's Wrong?

How many of these mistakes would you be apt to make in finishing a room with plywood wallboard? There are six shown by the artist, two in the first drawing. After you have decided what's wrong, turn the page upside down for the correct answers given below.

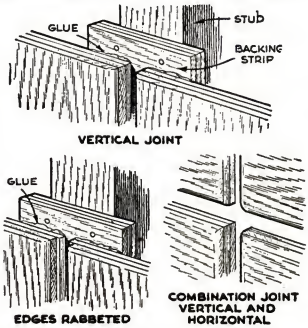
ANSWERS

1. Start nailing at the center of the edge. Stretchers are needed between studs for backing on which to nail top and bottom edges.
2. Corner and door and window-frame joints must be open to allow for movement of the frame.
3. Don't glue to studs. Nail furring strips on before gluing.
4. Use plywood strips with the face grain running crosswise.
5. Two coats of asphalt paint are required on the side of the panel next to the studs to minimize condensation inside the wall.




## OPEN-JOINT PLYWOOD WALLS

[WOODWORKING]




Open-joint installations of interior plywood wallboard are economical and decorative, emphasizing rather than hiding the joints. Usually sheets running from floor to ceiling are used, with vertical joints spaced 4' apart.

For best results make careful layouts of the walls to determine the best location of the joints.

Nail plywood backing or furring strips to the studs, with the grain crosswise of the panels, and glue the edges of the sheets to these strips. Use a damp cloth to clean off squeezed-out glue before it sets.

Open joints permit considerable variation in design, for the edges may be square, "broken," quarter round, beveled, or coved. Any such treatment may be combined with rabbeted edges.

For horizontal joints nail stretchers between the studs to carry horizontal backing strips. Combinations of vertical and horizontal joints are effective. They permit cutting sheets into smaller units to exploit various joint effects more fully.

POPULAR SCIENCE MONTHLY SHOP DATA

One of the lamp brooders first developed by the Extension Service of Louisiana State University. About 20,000 are now in use in Louisiana, and the type is popular throughout the South.

Ideal for the back-yard poultryman is this homemade version. Heated by electricity, it needs no attention.

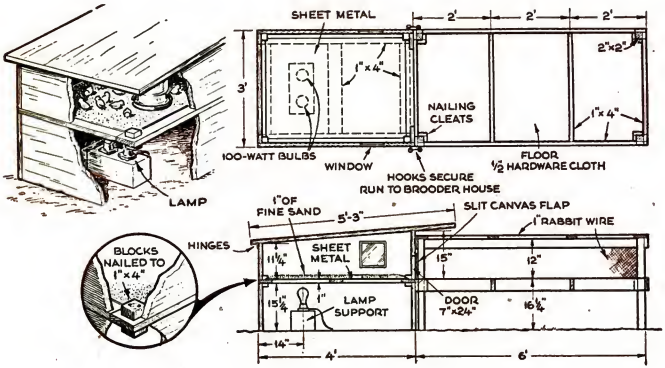
# Lamp-Bulb Brooder Cares for 100 Chicks

RAISING my own chickens became practical when I built a brooder of the type devised by the University of Louisiana. Occupying only 3′ by 10′ of back-yard space, it accommodates 100 baby chicks to the age of six weeks, or 60 to 1½ lb., which is broiler weight. Heat is transmitted through a sand-covered floor, and no thermostat is necessary, as the chicks settle down in the sand to obtain the most comfortable temperature.

Two 3′ by 4′ sections or open boxes, the upper one with two glazed windows and a 7″ by 24″ door opening on the run, constitute the brooder. The floor, a framework of 1″ by 4″ stock covered with galvanized iron, is positioned atop the lower section by small blocks at the corners, as shown below. The upper section rests on the floor frame over similar blocks. The sheet iron is nailed on top of the framework for electric heating, but if an oil lamp is to be used, nail it to the underside instead, and provide several vent holes around the top of the lower section. Cover the metal with 1″ of fine sand.

I used two 100-watt lamps placed 1″ below the floor, and covered the sides of the brooder with scrap roofing to help retain heat. For cold weather the brooder door is fitted with a canvas flap, slitted at intervals to allow the chicks passage.

The run floor is hardware cloth, carried around the legs on nailing cleats. Hooks and eyes hold the run to the brooder and also secure the roof of the run, a screen-covered frame, to the sides. The brooder roof is hinged for cleaning.—ORVILLE J. GRISIER.



## Tricky Tool Removes Plugs of Sod for Subsoil Fertilizing

EMPLOYEES of the city of Tucson, Ariz., have developed a novel method of nourishing trees and shrubs without unsightly surface application of fertilizer. P. J. Martin, Jr. and C. B. Maguire, at right below, devised a tool for removing divots of turf. Fertilizer is then poured into the resulting holes from a hopper. When the plugs of sod are replaced, no scars remain.

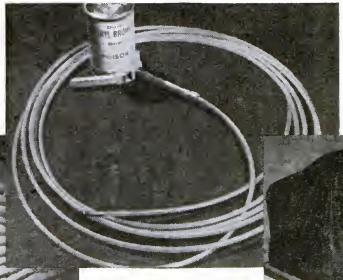
Somewhat like a small post auger, the tool has two sharp teeth that cut cleanly into the turf as deeply as 12". A plunger inside the barrel forces the plug out.

From the base of a tree, applications are usually made 15" to 18" apart out to the diameter of the branches. It has been found that this spotting of fertilizer reaches most of the root system. The photo at the left below, taken in one of Tucson's parks, shows the device in use in the foreground and, at the far left, how fertilizer is poured from a sheet-metal hopper.

## Plastic Envelope and Fumigating Gas Kill Insects in Foods

STORED foods, grain, and seeds, if threatened by insects, can be protected by an on-the-spot gas impregnation method when regular fumigating facilities are lacking. It is not necessary to move or even restack the containers. The active gas, methyl bromide, is available in cans and cylinders. It works in a few hours to kill insect life in all stages, and is so volatile that it vanishes completely upon subsequent airing. The method can be applied with equal success to loaded boxcars, trucks, and ships' holds. A photo below shows how a plastic tarpaulin is used for fumigation of small lots.

Here insect-infested rice is ready for fumigation, with a plastic tube leading out from the stack for connection to a container of methyl bromide.



Above, how plastic tubing is clamped to a can of the concentrated gas.

A gas-proof tarpaulin thrown over the bags is weighted down with sand-filled canvas "snakes". The gas, a poison, should be used by trained men.

# Supermodels for Our Indoor Navy

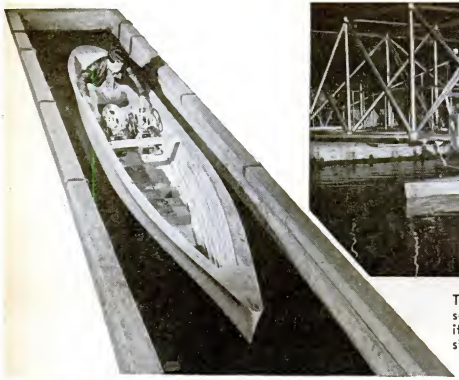
Navy model craftsmen assemble wood lifts for newly designed hulls, glue them in a huge glue press, and then carve the shape with spokeshaves, planes, and the like.

FINE craftsmanship and methods familiar to modelmakers are employed by the Navy in building test models of new hull designs. In the photo at left and in that just below will be recognized the lift, sometimes called bread-and-butter, method of construction often used in building model ships. Wooden lifts are glued together in a huge glue press, and the steps are then carefully carved down to conform to hull templates.

The hulls are built and tested at the David Taylor model basin, which is operating at Carderock, Md., on the Potomac River.

How the lifts look on the inside can be seen here and at left below. The outsides of the hulls are finished smooth.

Twin dynamometers are installed in a 20′ hull and checked in a channel leading to the large model-testing basin.



This 42-ton carriage, equipped with sensitive instruments, tows a hull on its basin trip to test power and design under sea conditions.

**KODAK ORTHO-X** (sheets)—top-speed ortho film. Gives ruddy skin effects, hence popular for pictures of men.

**KODAK PANATOMIC-X** (sheets, miniature rolls)—extremely fine grain, first choice for *big* enlargements.

**KODAK PORTRAIT PANCHROMATIC** (sheets)—a favorite multi-purpose film, especially valuable for portraits.

# First step to a finer picture ...the right Kodak Film

**KODAK PLUS-X** (rolls, packs)—all-around "pan" film; combines high speed, fine grain.

**. . . And it won't be long** before these seven favorites, and the rest of the Kodak Film family, will be back on Kodak dealers' shelves. The supply is steadily improving.

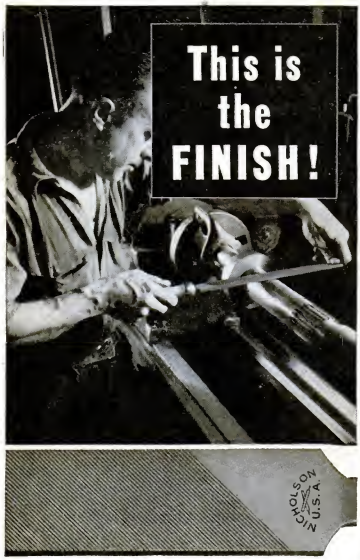
**KODAK SUPER-XX** (rolls, packs)—favorite high-speed film for both outdoors and indoors.

**At your Kodak dealer's . . . Eastman Kodak Company, Rochester 4, N. Y.**

**KODAK SUPER PANCHRO-PRESS, TYPE B** (sheets)—high speed, good highlight separation. Outstanding for portraits.

**KODAK VERICHROME** (rolls, packs)—fast, orthochromatic. America's favorite snapshot film by a wide margin.

Kodak




IT'S the kind of perfect-fit finish that usually results when human skill and *The right file for the job* get together. A Nicholson Long Angle Lathe File is shown removing the last few thousandths inch from a shaft. The same file will do the final smooth-finishing.

Because of the 45° angle of its teeth, it will, under light pressure, remove metal faster than a regular Mill file used as a "lathe" file. This long angle overcomes filling up—keeps file cutting and avoids scratching the surface of the work. Chips slide down the gullets and are forced out by the motion of the work—making file self-clearing, clean-shearing, non-chattering. Excellent for lathe-using hobbyists, as well as for industrial mechanics. Purchasable through mill-supply houses. Your hardware store also can get this special-purpose file for you.

**FREE BOOK, "*FILE FILOSOPHY*,"** on kinds, use and care of files—48 interesting illustrated pages.

NICHOLSON U.S.A.

**NICHOLSON FILE CO.**
**19 Acorn St., Providence 1, R. I.**
*(In Canada, Port Hope, Ont.)*

BLACK DIAMOND TRADE MARK

**NICHOLSON FILES** *FOR EVERY PURPOSE*

## Light Hand-Nailer Saves Time

LOADED and operated much like a stapler, a 3½-pound, portable hand-nailing machine made by Spotnails, Inc., of Chicago, drives nails ½, ⅝, ¾, and ⅞ inches long in soft wood and plywood. The galvanized, hook-headed nails come in cohered strips. Guide plates place the work and spot the nails.

## Fiery Liquid Turned to Soap

NAPALM, potent incendiary agent used in flame throwers during the war, has been converted cheaply to a satisfactory liquid soap by the Oahu (Hawaii) Chemical Warfare Service command. Machinery that once mixed Napalm to burn Japs out of caves will turn current stocks into 50,000 gallons of soap within a few months and help to ease the current shortage of that product.


**Model Builders *Attention!***

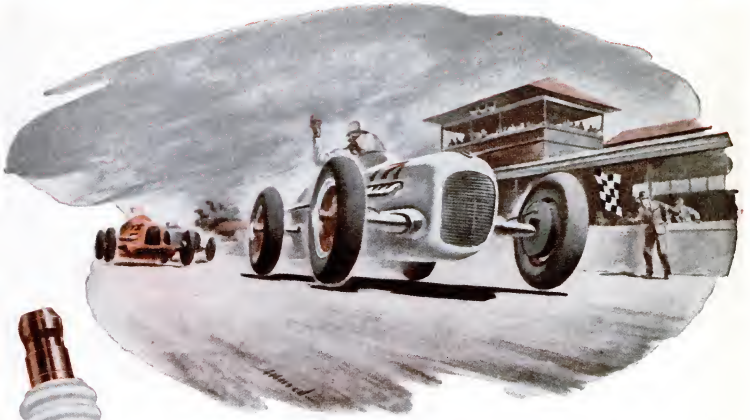
Actual Size V-Plug

| | V | V-2 | V-3 |
|---|---|---|---|
| Hex | ½" | ⅜" | 5/16" |
| Thread | ⅜"-24 | ¼"-32 | ¼"-32 |
| Thread Length | 7/32 | 7/32 | 5/32 |
| Weight, Grams | 8 | 3½ | 2½ |

**Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Sillment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.**

**CHAMPION**
SPARK PLUG COMPANY • TOLEDO 1, OHIO

# Here's why most Race Drivers specify Champion Spark Plugs



## THEY'RE DEPENDABLE!

**The vast majority of racing drivers use Champion Spark Plugs because they can depend upon them to give championship performance. There are many reasons why this is so, but the end results are contained in the record books on racing—on land, water and in the air. They show that Champions are true champions, in fact as well as in name—a fact worth remembering when you need spark plugs for your car. Champion Spark Plug Company, Toledo 1, Ohio.**

**FOLLOW THE EXPERTS . . . DEMAND DEPENDABLE CHAMPIONS**

# Ingenious New Technical Methods

To Help You with Your Reconversion Problems

## New Portable Grinder Lasts Longer ... Increases Production

The Portable Gaston Grinder

**The Portable Gaston Grinder** is designed for the grinding and sanding of metal—also, with wire brushes, for paint and rust removal. Because it is powered by a 3-phase motor, without brushes, commutators or gears, the Gaston will give long service.

The Gaston Grinder starts at full speed. Its speed remains constant regardless of extra pressure by the operator. This controlled speed under heavy load, eliminates glazing of the grinding wheel; produces a better ground surface.

**Three sizes** of dust-tight Gaston Grinders are available. Furnished in either "cup-wheel" or "edge-wheel" type, as desired.

**In a dusty** work atmosphere, that causes throat irritation and dryness, chewing Wrigley's Spearmint Gum helps keep workers' mouths moist and fresh—thereby reducing work interruptions—and "time out" to the drinking fountain.

Workers can stay at their machine, while chewing Wrigley's Spearmint—even when their hands are busy. There is no lost time. And the pleasant chewing helps keep them alert and wide-awake. One Connecticut manufacturer with a dust problem reports group production up about 3% over normal, when workers were given chewing gum. Other plants and factories everywhere, claim stepped-up efficiency when chewing gum is made available to all.

*You can get complete information from William H. Howland, 2533 East 73rd Street, Chicago 49, Illinois*

AA-72

**Piston rings wear out, too**

Billions of miles of good engine life go up in smoke every year—the smoke that pours out of automobile exhausts. Plain as day this smoke says: "Your piston rings are worn out. Replace them immediately!"

Smoke is only one symptom of worn-out rings. Others are: oil-pumping . . . slow get-away . . . loss of power. At the first sign of any of these symptoms, take your car to a motor specialist for a complete check-up.

If new rings are needed, it will pay to get Hastings piston rings. They *stop* oil-pumping, *check* cylinder wear, *restore* performance.

HASTINGS MANUFACTURING COMPANY • HASTINGS, MICHIGAN
Hastings Ltd., Toronto

TOUGH BUT OH SO GENTLE

**HASTINGS** STEEL-VENT **PISTON RINGS**

TOUGH ON OIL-PUMPING GENTLE ON CYLINDER WALLS

**Only Forecaster Superb Pipes have this**

# New FILTER*

**Cleans, cools, filters smoke • Traps nicotine • Prevents drip**

Enjoy a clean, cool, dry smoke always from a Forecaster • The exclusive aluminum winder can be removed in a jiffy—change cleaner as often as you like. • Choice, rich-grained briar, in a variety of popular shapes. • Ask to see the Forecaster Pipe display at your favorite dealer.

**$1.50**

Sir Sheldon Pipes, $2.50

**NATIONAL BRIAR PIPE CO • JERSEY CITY, N. J.**

## Wind-Tunnel Tests for Cars

Quarter-size car models are undergoing wind-tunnel tests at the University of Michigan as part of a new technique in the development of automobile designs. Though the model above, one of several built by the Studebaker Corp., appears to rest on the platform it is actually suspended by wires at four points. Paul McKee, research assistant, here tightens one of them.

## Americans Are Urged to Give Canned Foods to Needy Abroad

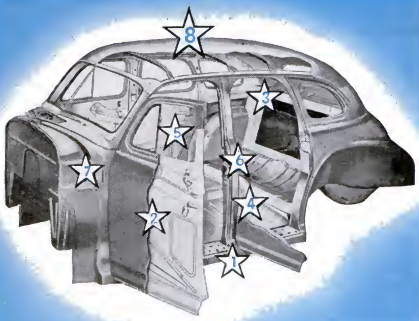
A quarter of the world's population is facing death from starvation and diseases caused by malnutrition. Even though the United States and other countries have been sending shipments of food to the needy in all parts of the world, the demand for supplies far exceeds what has already been sent.

You may help feed the hungry in war-devastated areas by taking any extra canned food you have to the Emergency Food Collection depot nearest your home.

Emergency Food Collection, working with UNRRA, is endeavoring to supplement the minimum subsistence diet planned in the relief program for warding off famine abroad.

Food in tins and money to buy more food are being collected. The kinds of food most needed are: milk (condensed, evaporated, or dried), meat, fish, and peanut butter.

# BETTER BY FAR IN SAFETY




THE solid security of the new Body by Fisher is doubly assured by special engineering at such points as these in the structural drawing shown above.

Inside and out, you'll find numerous evidences of the extra care Fisher Body craftsmen take to make safety certain in the bodies they build. And when it comes to beauty and comfort, you can actually see and feel the difference their special "know-how" makes.

Small wonder, then, that seven out of ten motorists say they prefer a car with Body by Fisher. Be sure your new car has one, by looking for the Body by Fisher emblem. It is your assurance of the skilled work that more than 37 years of coachcraft provide.

1. Heavier metal at vital points.
2. Outer and inner door panels welded into one solid unit.
3. Box-type rear-end braces give added protection against weaving and twisting.
4. Solid steel floor especially ribbed for extra strength.
5. Genuine safety plate glass is used in side windows and venti-panes as well as the windshield.
6. Three U-shaped steel channels welded together to form center pillar.
7. Ruggedly braced steel cowl and dash.
8. One-piece solid steel Turret Top completes the all-round safety that is yours in the Unisteel Body by Fisher.

*Body by Fisher*

**BETTER BY FAR**

***Thousands of dollars in university scholarships and cash awards for best model Napoleonic coaches or miniature cars submitted by boys of 12-19 years inclusive. For information, write: Fisher Body Craftsman's Guild, General Motors Bldg., Detroit 2, Michigan.***

**You get Body by Fisher *only* on General Motors cars**

CHEVROLET • PONTIAC
OLDSMOBILE • BUICK
CADILLAC

*The New 1946 Chevrolet Fleetmaster Sport Sedan*

# BURBANK DOES IT!...SO CAN YOU!

## How Expert Model Builder Gets Topnotch Results

James W. Burbank, of Narrowsburg, N. Y., builds scale models of famous old locomotives. He's a perfectionist. When he finishes a model, it looks real enough to chug off under its own steam.

Here you see him finishing the inlaid walnut cab for his model of the Erie's old George C. Bernard, speed demon of the 1870's. You see, too, three good reasons why he turns out such beautiful work, i.e., the picture of the original engine; his own accurate scale design; *and* his *indispensable* X-acto Knife Set.

"X-acto Knives are tops," says hobbycrafter Burbank. "They're so versatile. I can find a blade-handle combination for the toughest or most delicate jobs . . . And those little pin vises . . . their heads fit my hands perfectly. I recommend X-acto to every model builder!"

### Be Expert At Your Hobby!

X-acto adds skill to your wrist. Smooth-cutting, easy to use as a pencil, X-acto is the indispensable tool for whittlers, wood carvers, artists, photographers.

**No. 85 X-acto Tool Chest** – 3 all-metal knives; full assortment of blades; saw; sander; stripper; planer; 2 drill holders; 10 drills; 6" steel ruler; Complete in wooden chest, $12.50. Also #84 Set, $7.50.

## V is for Versatile . . . as in X-ACTO!

X-acto's 3 handle styles and 13 blade shapes fit every type of cutting job. But if you're a one-knife man, we recommend for all-round work . . .

**X-ACTO No. 2 KNIFE,** with solid duraluminum handle, made with new improved chuck collet. Knife alone, 50c. With 5 assorted blades, in #52 Set, $1.

**WHITTLE A LITTLE?** Send 10c for a copy of "Whittling Is Easy with X-acto!" You'll be an expert in no time.

**YOU'LL BE VERSATILE, TOO.** Send for these helpful booklets, 10c each. (1) Building Your First Flying Model. (2) The Knife As a Drawing Instrument. (3) Commercial Artists Handbook. (4) How To Build Scale Model Planes.

**SAVES CUT FINGERS**—X-acto is designed for firm grip and sure control. Blades lock in, can't fold under. So much handier and *safer* than razor blades.

**OK, JUNIOR!** Here's your X-acto Junior Knife, shaped like a Spitfire fuselage, with a two-edged blade. All-metal. Only 25c.

**X-acto*** KNIVES & TOOLS

X-acto Knives & Knife Chests From 50c to $5.00

Buy where you see this sign. At better hardware, hobby and gift shops – or if not available write direct to X-acto Crescent Products Co., Inc., 440 Fourth Avenue, New York 16, N. Y.

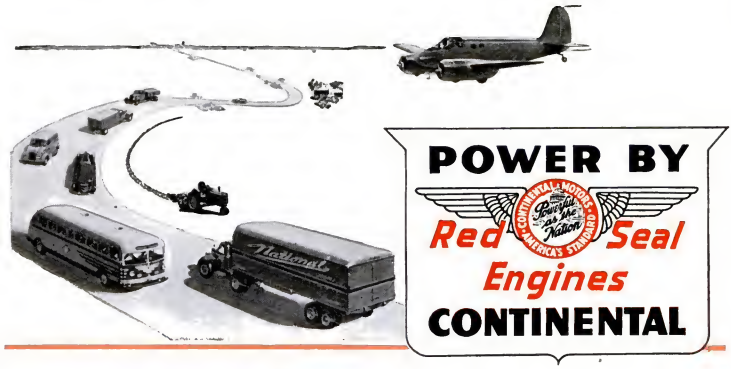
*Reg. U. S. Pat. Off.

# POWER

## BY CONTINENTAL

**From the half-horse Tiny Tim to heavy duty Diesels, the Continental *Red Seal* identifies engines world famous for their stamina, economy, and all-round reliability.**

**The Continental line is *complete*. It includes a wide range of engines, each expressly designed to meet a specialized need in aviation, transportation, industry or on the farm. There are Red Seal engines for use with gasoline, natural gas, and distillate. And production has now started on Continental Diesels with "Cushioned Power" Combustion Chamber for greatest fuel economy, still further broadening the applications of *Continental Power*. Continental Red Seal Engines are *on the job wherever* there's work to do.**




# CONTINENTAL MOTORS

**CORPORATION — MUSKEGON, MICHIGAN**

**44 YEARS' EXPERIENCE BUILDING ENGINES FOR INDUSTRY, TRANSPORTATION, AVIATION, AND THE FARM**

# The making of Marlin GUNS

***Marlin brings to sportsmen, through this series of advertisements, interesting facts on gun-making ... to enhance appreciation of fine sporting firearms and to encourage their thoughtful handling and care.***

*Tool-Making is Handwork of Infinite Precision*

**TOOL-MAKING** • In the modern Marlin plant, jigs, dies and gauges make possible the manufacture of parts so precise and uniform as to be completely interchangeable. These basic tools control cutting operations of automatic machines, check uniformity of parts.

**HAND PLUS MIND** • Tool-*design* requires skilled engineering. Tools are *made* by hand...by talented, experienced craftsmen.

Tooling is starting-point and heart of modern line production...a system which produces fine rifles and shotguns in volume, at prices within the reach of all.

*GUN REPAIR Also Requires Know-How and High Skill*

*REPRINTS of advertisements on the Making of Marlin Guns will be sent FREE to sportsmen on request.*

THE **Marlin** FIREARMS COMPANY

NEW HAVEN, CONN., U. S. A. • FOUNDED IN 1870

**BE SURE TO SEE MARLIN 1946 MODELS ON DISPLAY AT YOUR DEALER'S**

## New Rifle Kicks Downward

TWO NEW-TYPE guns have recently been designed by Chief Gunner's Mate James E. Sieg, of the U. S. Coast Guard. First is the Sieg Automatic Rifle, which goes present types one or two better. Owing to a compensator that balances recoil shock, the kick is negligible, and the muzzle, on firing, depresses unless the front is supported. The gun is .30'06 cal., weighs 10⅝ pounds, and is 36 inches long. Magazine holds 20 rounds, and the rate of fire is from 650 to 700 rounds per minute. The double trigger is pivoted for semi- or full-automatic fire.

Sieg's other invention is a line-throwing gun that establishes new standards in range and accuracy, developed for use by the U. S. Merchant Marine. It is .50 cal., and uses a four-pound projectile with a 150-pound-test nylon line. One type of projectile has mechanism for firing a carbon dioxide cartridge that inflates a "doughnut" float when it hits the water. The gun has a range of 400 yards, and can be fired without setting it into a stationary mount.

# Switch to — AUTO-LITE

Money cannot buy a better spark plug

TUNE IN THE AUTO-LITE RADIO SHOW STARRING DICK HAYMES—SATURDAYS 8:00 P.M.—E.S.T. ON CBS

*The Spark Plug that's Ignition Engineered*

Auto-Lite spark plugs are designed by the same engineers who design complete electrical systems for leading cars and trucks. This specialized engineering experience is one reason why money cannot buy a better spark plug. A complete set of ignition engineered Auto-Lite spark plugs in your car, helps give you quick starts, and full mileage from every gallon of gas. So switch to Auto-Lite when faulty spark plugs need replacing. See your Auto-Lite Spark Plug Dealer today.

Continuing tests and scientific research, plus 35 years' experience designing complete ignition systems, enable Auto-Lite ignition engineers to maintain one high standard of quality.

**THE ELECTRIC AUTO-LITE COMPANY**
Toronto 1, Ontario — Toledo 1, Ohio

**AUTO-LITE SPARK PLUGS**

THE ONE AND ONLY PIPE OF ITS KIND

# VanRoy with the Ajustomatic STEM

FREE-TURNING—SELF-ALIGNING

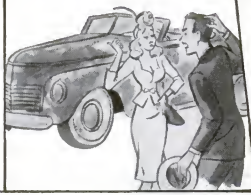
VanRoy Ajustomatic Bard $5

VanRoy Ajustomatic holds a man's affection; it is the only screw stem pipe that maintains perfect alignment of stem and bowl throughout its long, happy life! The exclusive VanRoy patent, "float-mounting"—allows free turning of the stem but grips it snugly *in any position*. The stem can't lock at an off angle, always lines up as straight as a die. A remarkable innovation, worthy of the VanRoy tradition of eminently fine quality. VANROY COMPANY, INC., Empire State Building, N. Y. 1, N. Y.

SIGNET OF QUALITY IN PIPES

GAL WON'T GO

'CAUSE CAR'S A MESS



Just try No. 7

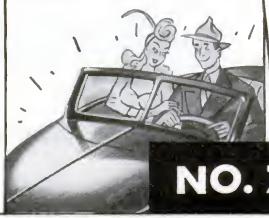
You'll say it's the easiest you ever used. This polish removes Traffic Film quickly—restores original color and lustre. If you want a brilliant job in half the time, use Du Pont No. 7 Polish.

DU PONT

Better Things for Better Living . . . Through Chemistry

THIS QUICK SHINE-UP

MAKES "NO" A "YES"



NO. 7 POLISH

# ALL YOURS with an Evinrude

Check every quality and feature you want in a modern outboard motor . . . chances are, you'll find that Evinrude offers every one . . . *and more!* Each developed and perfected the sure and steady way . . . through 37 years of progressive engineering, experimenting, *proving.* That background is worth remembering—when you choose an outboard motor!

**Want Sure Starting?** Fine! That's an Evinrude "specialty" . . . always, on every model, it's mechanically *built right in!*

**Co-Pilot Steering!** On every model the "unseen hand" that grips when you let go . . . holds the motor on the course you set.

**Operating Ease!** — with controls so simple and troubleproof that even youngsters handle an Evinrude easily and capably.

**Quiet! Smooth!** Perfected underwater silencing buries exhaust fumes and noise. Float in vibration-absorbing bearings.

**Slow Trolling Speed!**—enables you to check right down to a slow trolling glide without choking, stuttering or stalling.

**Full Reverse!** On two great fishing models — provides instant reverse, utmost maneuverability, 360 degree steering.

**Four-cylinder Performance!** Nothing like it for smoothness, thrilling responsiveness — and Evinrude offers it in four models!

**Widest Range of Models!** The right motor, for every boat, every service. Eight models, all with O.B.C. horsepower certification.

It all adds up to finer *performance!* And back of every Evinrude is the priceless advantage of organized, responsible, nationwide *service* . . . available everywhere through a veteran organization of selected dealers. *See your Evinrude dealer* — look for his name in your classified phone directory under "Outboard Motors". *Catalog free!* Address, EVINRUDE MOTORS, 5298 N. 27th St., Milwaukee 9, Wisconsin

*In Canada: Evinrude Motors, Peterboro, Ontario*

**EVINRUDE**

OUTBOARD MOTORS

# HOW TO GET THE MOST OUT OF BETTER FUEL

Don't expect to fill your tank with the new, higher-octane gas and get top-grade performance from spark plugs you may have switched to during the war. Now that you're getting far better fuel—and have returned to normal driving—you need to consult your service station about changing to AC plugs that run *cooler* than those you may have used with wartime fuels.

The correct type of plug is *necessary* to avoid hard starting—loss of power—waste of gas—cracked insulators—rapid electrode wear—excessive oxide coating—misfiring under heavy loads.

The AC Heat Range, and today's wider heat range per plug, enable you to fit spark plugs exactly to engine operating conditions. That's why AC's were standard equipment on 2 of every 4 new cars and trucks—why your Registered AC Dealer can help you to get the *utmost reliability* in spark plug performance. Have your plugs checked today. Be sure you have the type that will give you the best in performance.

**AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION**

CLEAN PLUGS SAVE UP TO ONE GALLON OF GAS IN TEN

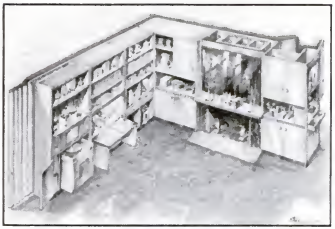
## Liquefies Dry Ice in 10 Mins.

TWENTY 50-pound blocks of dry ice are converted to liquid carbon dioxide within 10 minutes in the new Jumbo Liquefier (above). Its 1,000-pound capacity is seven times as much as that of the type previously in use. Designed by Mathieson, the Jumbo Liquefier is being manufactured by American Car and Foundry Co.

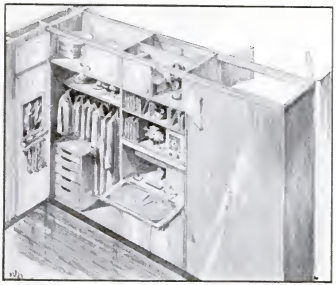
## Play Phone Goes to Work

ORIGINALLY designed as a $19.95 toy, the Utiliphone, two-way communication device made by Electronic Laboratories, Inc., of Indianapolis, has now been equipped with switches on both units for interoffice conversation. For adult use, it costs $29.95.

# Built For Your Future . . .
## *with hands skilled by the past*



*Defoe's "Working Walls"* are distinctly a modern innovation. They put between-room wall space to work for the housewife and provide more storage while actually saving room space.*



IT TAKES a lot of time and work to transform thought into reality. Things like the new Defoe Homes don't just happen. Back of them are the skill and experience born of more than forty years of painstaking workmanship under the exacting traditions of the shipbuilder's art.

• • For more than four decades everything Defoe has produced has been built to perform perfectly—and built to last! What the Defoe organization has learned in all those years has now been translated into the comfort, the convenience, and the economies of the new Defoe Homes. They will be a definite contribution to the better things for better living in the good times which lie just ahead.

*TRADE NAME REGISTERED

**Defoe HOMES**

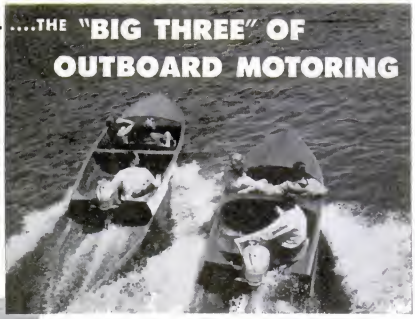
HOUSING DIVISION
DEFOE SHIPBUILDING COMPANY Dept. PS-6
BAY CITY, MICHIGAN

Please send me the descriptive brochure on the new Defoe Homes. Enclosed is 10c for handling and mailing costs.

*Name* _____

*Street* _____

*City and State* _____




**Full Range Performance!** You've heard of the motor that packs real power...*silken* power... at high speed, yet gives you velvet smoothness at a crawl? That's Johnson. Dual Carburetion (which Johnson brought to outboard motoring 10 years ago) accounts for this beautiful performance.

**Reverse!** Of *course* you want reverse. Reverse, with 360° Steering, is one of the "big three" of outboard motoring. (It was a Johnson feature nearly 25 years ago.) Steer forward, sidewise, turn around or back up... The Sea-Horse at right develops 5.0 O.B.C. CERTIFIED brake horsepower at 4000 r.p.m.

**JOHNSON BUILDS SEA-HORSE MOTORS ONLY —NO OTHERS**

**Wonderful Smoothness!** Twin-cylinder Alternate Firing, developed and perfected by Johnson, was introduced to America by Johnson 17 years ago. It gives you a wonderfully smooth flow of power. It is one of the "big three" of outboard motoring... The Sea-Horses above develop 16.0 O.B.C. CERTIFIED brake h.p. at 4000 r.p.m... For information on Johnson deliveries see your Johnson Dealer. Look for his name under "Outboard Motors" in your classified phone book.

**FREE HANDY CHART!** Write for your copy today. Describes all 5 models of the '46 Sea-Horse line.
JOHNSON MOTORS, 500 Pershing Road, Waukegan, Ill.

*There is No Substitute for Experience*

**JOHNSON SEA-HORSES for DEPENDability**

**Holidays are Camera Days**

**MAKE *SURE* OF BETTER PICTURES**

**Come back** with perfectly exposed pictures every time. It's easy with the new, improved G-E exposure meter to guide your camera. Gives you correct exposure in a jiffy. New, simplified dials make it easier, faster to use. Proved accuracy. Extreme sensitivity. And *now* lighter, sturdier. The ideal travel companion for your camera. A grand gift. See the G-E meter at photo dealers ... it's 3 meters in one. *General Electric, Schenectady 5, New York.*

New, improved **G-E EXPOSURE METER**

**GENERAL ELECTRIC**

606-170C

**REPAIRS**

**FURNITURE, TOYS**

... also broken china, glassware, torn luggage and books. This handy adhesive is waterproof, transparent and flexible. Get a tube today!

# HOW YOU CAN MAKE A SIMPLE STORAGE BATTERY

Put two small pieces of scrap lead in an ordinary glass partly filled with a weak solution of sulphuric acid and water . . . pass direct current from a battery charger through the unit for about a half hour . . . then reverse the direction for the same length of time. You have a storage battery . . . of very low capacity and very short life . . . yet it embodies the basic theory of storage battery construction.

Between this home-made battery and one that will give dependable service, stretches a wide gap. Between it and an Exide Battery this gap is bridged by 58 years of battery research, development and manufacturing experience. These are some of the reasons why so many millions of people say Exide is the world's finest storage battery. They know that—

**"WHEN IT'S AN *EXIDE* YOU START"**

Would you like to know how batteries function, and how to get the best results from them? Just mail a postal card to Exide and ask for FREE booklet, "The Storage Battery —Its Fundamentals, Use and Maintenance."

**Exide**
**BATTERIES**

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

**WORLD'S FIRST SUPER-SPEED, SUPER-PRECISION CANDID CAMERA**

## ESPECIALLY DESIGNED FOR COLOR!

**CHOSEN BY HARVARD OBSERVATORY** for supreme accuracy, the 1/1000 second rotary focal plane shutter is typical of the many advanced Mercury II features that assure you:

1. Sharper candid and action shots...
2. Richer portraits and still lifes...
3. Color shots clear and true right out to the edges, sharp in background as well as foreground.

**NEW FILM ECONOMY**—32 negatives on standard 35mm. 18-exposure color or black-and-white film cartridge, 65 exposures on 36-exposure cartridge.

**UNIVERSAL CAMERA CORPORATION**
New York • Chicago • Hollywood

**MERCURY II**
*...It's a UNIVERSAL*

## THIS INVESTMENT COMBINES DIVIDENDS WITH HAPPY LIVING

Pensacola, Florida, offers extraordinary opportunities for the development of beach vacation cottage colonies and other types of summer and winter vacation accommodations for which there is an active demand now.

Pensacola has large areas of beautiful, accessible, undeveloped Gulf beaches. Pensacola is growing in importance as a summer and winter vacation resort and as an industrial city.

A few thousand dollars invested in a Pensacola beach cottage colony development should yield you not only a good income but also happy, comfortable living in an ideal climate. Write for information today.

**Department C,**
**MUNICIPAL ADVERTISING BOARD**
**22 West Garden Street, Pensacola, Florida**

**Sand Casting—Forging—Heat Treating—Case Hardening**

## BRONZE FOUNDRY

is again available in limited quantity without priority. Orders filled in sequence as received. INVENTORS-SCHOOLS-CRAFTSMEN use FOUNDRYETTE for making castings quickly for new inventions, for instruction, and general purpose. Order now for early delivery. Three sizes are available capable of making bronze castings of 1½, 3, and 6 pounds weight, aluminum, copper, brass, etc. $17.50, $24.00, $34.50, f.o.b. Kansas City. Domestic gas supply and 110 volt AC or DC energy required for operation. Write for circular.

**KANSAS CITY SPECIALTIES CO.**
**Box 6022, Dept. S-67 Kansas City, Mo.**

MORE WORK IN LESS TIME with...

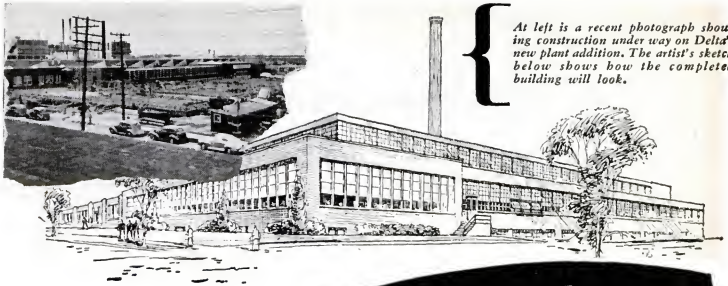
## HOLD-E-ZEE
**AUTOMATIC GRIP SCREWDRIVERS**

**Hold-E-Zees do the job better, faster. They excel wherever screwdrivers are used. Gripper instantly released by spring action, sliding up out of way when not in use. Highest quality materials throughout.**

At Leading Dealers Everywhere

PATENTED

**UPSON BROS., INC., 86 Exchange St., Rochester 4, N. Y.**



*At left is a recent photograph showing construction under way on Delta's new plant addition. The artist's sketch below shows how the completed building will look.*

# Building your Happiness

***New plant addition now under construction speeds the day you can enjoy***

## DELTA HOMECRAFT* POWER TOOLS

***in your home shop . . .***

We want you to enjoy the pleasure of using Delta Homecraft Power Tools. We want you to know the deep satisfaction that arises from working with *quality* tools like these.

Right now, though, the widespread demand for these famous power tools far exceeds the number we can produce. But we are cutting down the time you must wait until you *can* become the proud owner of Delta Homecraft Power Tools.

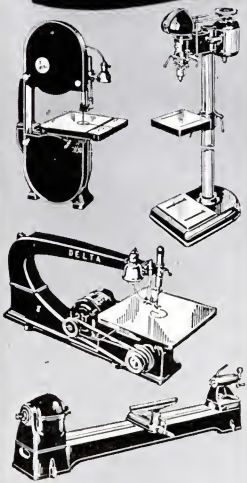
Shown here is our new plant addition scheduled for completion this summer—considerably increasing our capacity for building these tools. This is one way in which we will hasten Delta tools onto the floor of your nearby store.

We sincerely appreciate your patience thus far. Thanks!

Keep in touch with the store in your neighborhood that carries Delta Homecraft Power Tools.

*Trade Mark Reg. U. S. Pat. Off.

HM-37




DELTA MILWAUKEE HOMECRAFT POWER TOOLS

Subsidiary of Rockwell Manufacturing Co.

**Tear out coupon and mail today!**

### FREE!

**"Happiness Herald"** — a tabloid newspaper that gives interesting facts, in words and pictures, about the fascinating woodworking hobby. Pictures typical shops and projects. Enjoy its inspiration and ideas. Send coupon for your free copy.

**THE DELTA MANUFACTURING CO.**
**683F E. Vienna Ave., Milwaukee 1, Wis.**

*Please send me my free copy of the "Happiness Herald."*

Name.....

Address.....

City.....(.....) State.....

# It's Good to See Good Tackle Again!

That's exactly what we overheard anglers say when they saw the first South Bend Quality Tackle made since the war! Here are rods, reels, lines and baits now being made. Not enough for all, it's true, so see your dealer early.

**Most Popular Automatic Fly Reel**

When you try an Oren-O-Matic, you'll know why it's so highly prized by fly rod anglers. Two sizes: No. 1130, capacity 26 yards D line; No. 1140, capacity 34 yards D line.

**Two Great Fly Rods—No. 47 and No. 59**

The No. 47 Fly Rod, shown here, is the favorite of anglers who want the extra snap and fast action of flame-finished split bamboo. Exclusive South Bend Comficient Grip and end-locking reel seat. The popular No. 59, lower in price, is also in production now.

**Dependable Black-Oreno—Now Braided of NYLON**

World-famed Black-Oreno is now being made—of NYLON! Smooth, pliable, easier casting, longer lasting, new moderate prices. Made in 12, 15, 20, 25, and 30-pound tests.

**A Really Great Bait—The No. 1991 FISH-OBITE**

We wish we could make enough of these wonder baits to meet the demand! Made of indestructible plastic, in the famous South Bend red arrowhead, white body pattern.

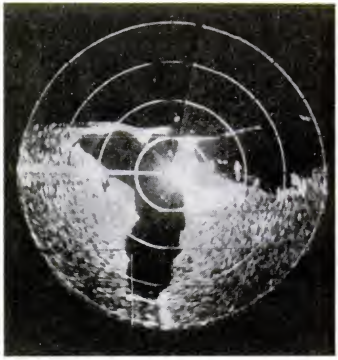
**Fishing Photo Book—FREE**

A 48-page book filled with action photos—every one a winner in the South Bend Fishing Photo Contest. Send a card today. Ask for "Fishing Photo Book."

**SOUTH BEND BAIT COMPANY, 892 HIGH ST., SOUTH BEND 23, IND.**

# SOUTH BEND

*A Name Famous in Fishing*

## Mobile Bay by Radar Camera

THIS is a picture of Mobile Bay, scene of the famous Civil War battle, and its environs taken with the U. S. Army's new 35-mm. radar camera, a product of Fairchild Camera & Instrument Corp. The camera photographed the radar screen of an Army plane flying out of Eglin Field, Florida, and the picture it obtained shows an area about 60 miles in diameter. It can be used with every type of airborne and shipboard radar and is expected to be adapted for ground use as well.

## Tooth Decay May Be Preventable

IT MAY soon be possible to prevent cavities by using a mouth wash and tooth powder containing ammonia. This hope is held out in a report to the Chicago Dental Society of studies that four University of Illinois scientists have recently made. But don't start using household ammonia or spirits of ammonia in a private attempt to end trips to the dentist. The prescriptions being tested use dibasic ammonium phosphate—something else again—and it will be 18 months to two years before the scientists can be sure that they will prevent tooth decay.

This much is now certain: Patients who have used the ammonia rinse and powder say that their mouths feel "exceptionally clean" and dental examinations show that their teeth are unusually free of white matter and deposits usually present in cases of active decay. Their mouths also show a marked reduction in the number of *Lactobacilli acidophilus*, micro-organisms that are used as a yardstick of susceptibility to tooth decay.

# 8 HOURS FROM NOW—YOU CAN SOLO AERONCA!

## *Your Personal Plane is here!*

**NO OTHER PLANE GIVES SO MUCH FOR THE MONEY!**

**Take a demonstration flight in the "Plane that almost flies itself"**

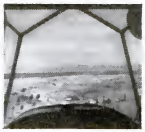
Look at these happy people! Soon they'll take off in their Aeronca to a favorite trout stream. It's hundreds of miles away. But no traffic lights or congested highways will delay them. They'll be there—in a few short hours.

Why put it off any longer! Go see Aeronca . . . the plane that has made flying simple.

Aeronca's new flying ease and economy of operation have made plane ownership practical. Two completely new models now in full production . . . Aeronca Champion (Tandem) and Chief (side-by-side model). Talk to your Aeronca dealer soon.

**Aeronca Aircraft Corporation**
**Middletown, Ohio**

**ROOMY CABINS,** wide comfortable seats. Aeronca gives 35 extra value features you'd never expect in a low priced plane.



**VISIBILITY!** Aeronca's greatly increased visibility has been hailed as one of today's greatest contributions to safety.

**SMOOTH LANDINGS!** Oleo landing gear makes Aeronca landings soft and comfortable. Improved brake system.

*So Safe—So Simple—Now*
**ANYBODY CAN FLY AERONCA!**
(THOUSANDS SOLO IN 8 HOURS OR LESS)

***Over 1000 Aeronca Qualified Dealers to serve you.***

**AERONCA** *America's No. 1 Low Cost Plane*

# From a smart Lad to a worthy Dad-

WATCH a man's eyes light up at the sight of a fine Biltmore Pipe. It's the right gift alright, always. Biltmores are choicest imported briar, beautifully finished, rich-grained, mounted with sterling silver bands, and sweet-smoking from the first puff. Packed in velvet bags and boxed. If not available at your dealer write Biltmore Pipe Co., 220 Fifth Ave., New York City.

Biltmore "RESERVE," $5.00 ★ Biltmore "BLUE RIBBON," $3.50 ★ Biltmore "DE LUXE," $2.50
Biltmore "EXECUTIVE," $7.50 ★ Biltmore "GOLDEN CREST," with ultra grain, $10

**Biltmore**

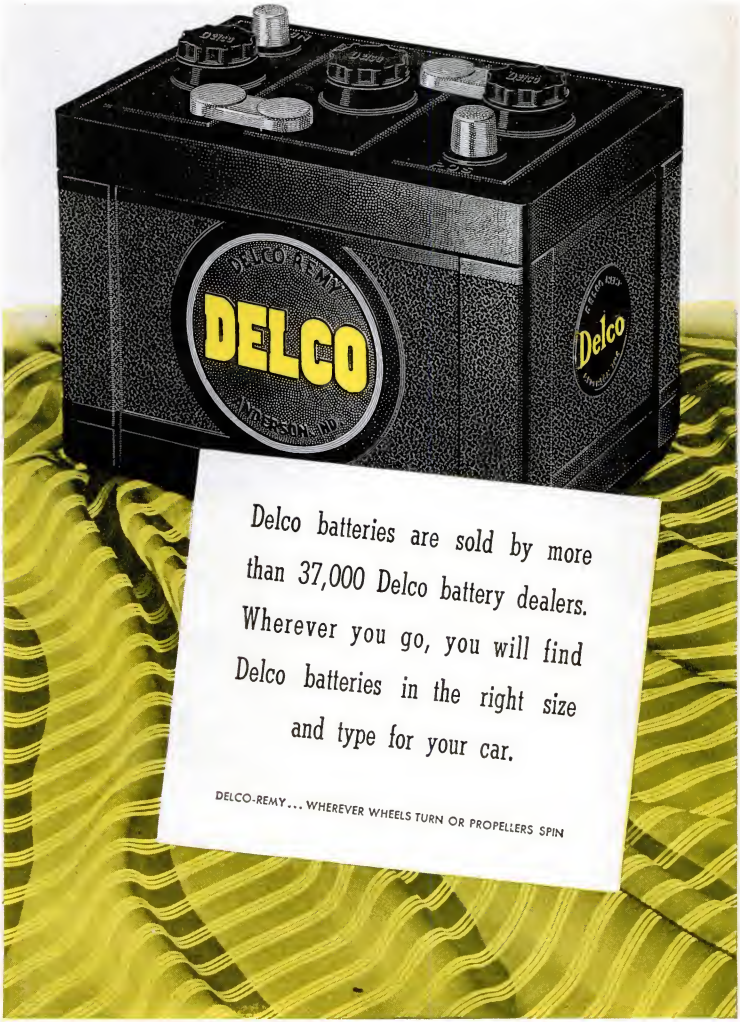
**IMPORTED BRIAR PIPES**

## Electric Chicken Plucker

LAY a scalded chicken or turkey against the whirling 4½-inch rubber fingers of this electric machine, and in a jiffy the bird will be stripped of feathers. Half a minute per chicken is average. Machine is made by Mercury Company, Los Angeles, Calif.

## New Electric Timer

HIGHLY accurate timing of all kinds is possible with an electronic device made by Electronic Controls, Inc., Newark, N. J. The time range is from one to 120 seconds, and snap-positioning step switches assure precision control, since exact values of resistance are inserted in the circuit at each position. The type of tube used is a 2050 thyratron.




Delco batteries are sold by more than 37,000 Delco battery dealers. Wherever you go, you will find Delco batteries in the right size and type for your car.

DELCO-REMY... WHEREVER WHEELS TURN OR PROPELLERS SPIN

**SAFETY**
**for your**
**SPORTS AFLOAT**

# Ta·pat·co

LIFE-SAVE VEST

*New Features*

**That Give New Comfort and Safety**

*Government Approved*

Light, easy to wear Ta-pat-co Life-Save Vests are back. Back with new safety and comfort features developed on war's testing ground. Topcoat flexibility—sit down, bend, twist, there is no binding action when you wear a Ta-pat-co. Unbelievable buoyancy—filled with finest new Java Kapok (five times more buoyant than cork), your Ta-pat-co can't lose air or come off in the water—even bullets couldn't sink it.

See the new Ta-pat-co Life-Save Vests and Life Preserver Cushions at your sporting goods store.

Ta-pat-co Sleeping Bags are back. Outdoor men everywhere are ready to hit the trail once more. When you see the new, lighter, warmer, and more compact Ta-pat-co you'll say "That's the bag for me".

**The AMERICAN PAD & TEXTILE CO.**

GREENFIELD OHIO



## We met in the Army

Reeves ARMY TWILL MADE TO GOVERNMENT SPECIFICATIONS SANFORIZED

*now I demand*

Over 90 million yards of Reeves Army Twill were purchased by Uncle Sam during the war. It has great tensile strength—resists tearing, snagging and scuffing. Its dyes are fast to sun, water and perspiration. Sanforized Shrunk*, it tailors smartly, holds its lines. It comes in a wide variety of colors. Demand Reeves Army Twill for better, more economical work clothes.

*Residual shrinkage less than 1%.

**REEVES BROTHERS, INC.**
54 Worth Street, New York 13, N. Y.

**Send 10c for Stanley Plan Set No. 14** Bird houses, nesting shelter and feed box, trellis and garden seat. Send 10c for 5 project designs. Stanley Tools, 266 Elm Street, New Britain, Conn.

## Give Dad a HULL AUTOMOBILE COMPASS

A Father's Day gift for his comfort and welfare when driving. He'll use the **HULL STREAMLINE AUTOMOBILE COMPASS** the year around, to stay on the right road, avoid lost directions, backtracking, delays. Circular free. At your dealer's. **Price $3.95.**

**HULL MFG. CO.**
**P.O. BOX 246-E7** **WARREN, OHIO**

## HUNTER'S COMPASS

**Hunting Case, Watch Type, All Metal, Jeweled** **$3.50**

***Engineers All Metal Army Type Hand-Sighting***

## LEVELS

**$1.50**

**PUBLIC SPORT SHOPS**
13 S. 16th St., Phila. 2, Pa. No COD's

# look SHARP

# feel SHARP

# be SHARP

# use Gillette

## Blue Blades

*with the* ***SHARPEST*** *edges ever honed!*

**You look SHARP** because you get the best-looking shaves any man ever had!

**You feel SHARP** because Gillette Blue Blades give you the quickest, most refreshing shaves of your life!

**You are SHARP** when you buy Gillette Blue Blades with the SHARPEST edges ever honed, because you get more shaves per blade and save money!

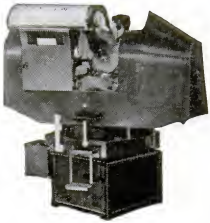
Copyright, 1946, by Gillette Safety Razor Company.

GILLETTE'S CAVALCADE OF SPORTS presents the major boxing event of the week every Friday night over American Broadcasting Company stations coast to coast

Gillette Safety Razor Company, Boston 6, Mass.

# LINK

## INSTRUMENT FLYING TRAINER



Long standard with the airlines and Army Air Forces, the Link simulates with amazing accuracy nearly all characteristics of a modern plane in flight. In the coming Air Age, Link training assures greater safety, skill and range for pilot and plane owner.

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**LINK AVIATION DEVICES, INC.**
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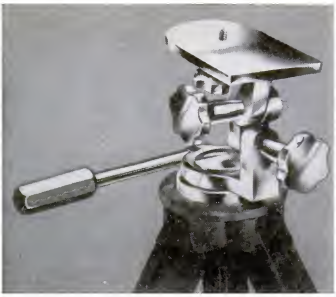
*Makers of Link Trainers, Crew Navigation Trainers and other devices contributing to the safety of flight.*

Link Training Is Your First Step Into The Flying Age

## Tripod Head Doesn't Slip

A NEW tripod head for movie or still cameras, called the Oxford All-Purpose Tri-Pan Head, turns in any direction. Yet, when set in one position, it remains absolutely rigid. Separate knobs for each adjustment assure that one setting will not slip while another is being made. It is made by Oxford Engineering, Inc., Oxford, Mich.

## Versatile Slide Projector

FINER projection of transparencies is claimed for the Filmo Slide Master, made by Bell & Howell Co., Chicago. Among the new features are interchangeable lamps of from 500 to 1,000 watts, and wind-tunnel cooling, with a draft of air forced by a Neoprene-mounted motor and fan, thermostatically controlled. The condenser assembly includes a double heat-absorbing filter having a high light-transmission power. Anastigmatic lenses are interchangeable; may be locked in focus.

## Gold Alloy Is Easy to Melt

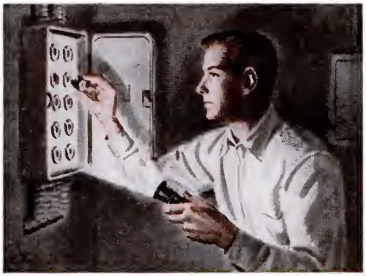
RECENT studies of a gold and germanium alloy in the proportion of 88 percent to 12 percent have been made to determine its possibilities as a rectifier in radar equipment. While the melting point of gold is 1,945 Fahr. and that of germanium is 1,760, the alloy melts at 673 Fahr., which is only 50 degrees higher than the melting point of lead. Harder than ordinary gold alloys, it has the advantage of expanding slightly as it solidifies.

# How to Avoid these "BOOBY TRAPS" in your home!

***What you can't see CAN hurt you—says the National Safety Council***

**1** About 5,000,000 Americans are injured every year *at home*—33,500 fatally! Largest single cause: *falling*. A roller skate on a dark staircase; shin-catching obstructions; slippery objects: these can be lethal "booby traps." To avoid them, carry your "Eveready" flashlight in dark areas.

**2** Be sure all obstacles are cleared away. Linoleum or carpeting should be tacked down firmly. In attic or basement, pack all loose objects in noninflammable boxes stored against the walls. Don't rely on *your* knowledge of where obstacles are located—the next person may not know.



**3** Know *in advance* where your fuse box, main water and gas valves, etc., are located; be sure you have a clear path to them. Armed with your "Eveready" flashlight, you can approach without fumbling in an emergency. Be sure loose wires are so placed that you won't trip over them.

**4** Keep your "Eveready" flashlight always in the same convenient place—so you won't be tempted to do without it because it can't be located. Keep it filled with "Eveready" batteries—they're again available at your dealer's. They are the *largest-selling* flashlight batteries in the world!

**NATIONAL CARBON COMPANY, INC.**
30 East 42nd Street, New York 17, N.Y.
*Unit of Union Carbide and Carbon Corporation*
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EVEREADY
TRADE MARK

*The registered trademark "Eveready" distinguishes products of National Carbon Company, Inc.*

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The Dustless brush is the only brush ever perfected for "Dustless" sweeping. This brush has a reservoir in its back for Arbitrin sweeping fluid. In the process of sweeping, Arbitrin filters through the brush and makes the best kind of sweeping compound out of every particle of dust it contacts. Besides reducing dust 97%, the Dustless brush also eliminates sweeping compound, saves labor and outlasts ordinary brushes 3 to 1. Get complete facts about this better method of sweeping. Write today.

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*Magic Weed Killer*

**Destroys Ugly Weeds but Won't Harm Common Lawn Grasses!**

**NO MORE** back-breaking digging! Destroy ugly leafy weeds with WEED-NO-MORE!

The 8-ounce lawn-size package treats 1600 square feet! Now *you* can enjoy a beautiful weed-free lawn for *only* $1!

WEED-NO-MORE kills dandelion, plantain and other ugly weeds—yet won't injure soil.

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***Made by THE SHERWIN-WILLIAMS Co. Cleveland, Ohio***

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28 Lawn Ornament Patterns, 25c. Other patterns; 15-20" high; Dutch Girl, Dutch Boy, Pirate, Bull Terrier, Mexican Girl, Mexican Boy, Dwarf, Penguin, Flower Girl, 10c each. 25 Novelty Patterns, 30c. **All 62 Full Size Patterns, $1.00 Postpaid. Strother Pattern Service, Dept. 7-E, Box 383, Belington, W. Va.**

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With our six inch tool steel cutters make mouldings, casings, drop-leaf tables, grooves beading and jointing. Moulding cutters, A 1 in. wide $1.50, 1½ in. $1.75, Jointing cutters, B 1 in. $1.50, 1½ in. $1.75, E 1 in. for drop-leaf tables, $1.50, E 1½ in. Makes ¾ in. cove & Quarter. $1.75 Postpaid. Guaranteed. State size hole. List & Folder free.

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*SEE YOUR DEALER OR WRITE FOR DESCRIPTIVE FOLDER*

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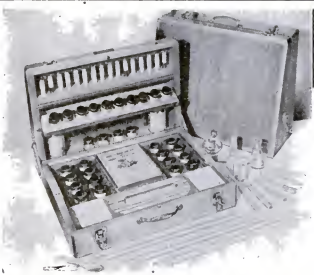


# *Interested in Chemistry?*

**THIS MODERN, COMPACT, PROFESSIONAL-TYPE CHEMISTRY KIT SERVES AS A PORTABLE CHEMICAL LABORATORY. MERCK & COMPANY CHEMICALS. TOP QUALITY MATERIALS THROUGHOUT.**

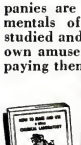
The atom bomb, the new war-born synthetics, plastics and textiles have focused America's attention on chemistry. To meet this widespread interest, Kit Corporation has produced a complete professional-type chemical laboratory kit to enable hobbyists and students to perform a wide range of experiments. These kits are currently being used by leading colleges and universities to expand their laboratory facilities to care for the greatly increased enrollment in advanced chemistry courses. More and more companies are looking for men who understand the fundamentals of chemistry. Many advanced hobbyists who studied and experimented with chemistry purely for their own amusement have suddenly found that their hobby is paying them big dividends in advancement and more pay.

Write for free descriptive literature and your dealer's name. If your dealer is out of stock, shipment can be made direct to you.

The Kit Corporation Senior Kit contains chemicals manufactured by Merck & Company, standard textbook on chemistry, Pyrex Erlenmeyer 50cc flask, six chemical test tubes, test tube holder, Pyrex beaker 50cc, six chemical vials, built-in test tube rack, wooden spatula, 100 strips blue and 100 strips red Litmus paper, six 12" strips glass tubing, atomic element and weight charts, chromium plated forceps, alcohol lamp, and 5cc pipette. All these materials contained in a beautifully finished wood cabinet 18" wide x 14" high and depth tapering 7" to 4". Weight 20 lbs. Two bottom trays removable, leaving a water-proof bottom which acts as a chemical resistant laboratory table. **$29.50**

Kit Corporation also manufactures the compact, well-balanced Junior Chemical Laboratory Kit, at $14.95, and the Young Scientist Chemical Labora-toy at $4.95.

*This authoritative, 140 page chemical experiment book is part of the kit.*



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*with interchangeable surgical steel blades!*

"1001" Knife as above, $1.29

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• *Buy "1001" wherever hobbycraft tools are sold. If your dealer cannot supply you, send check or money order for $1.29 (or $1.59) direct to*

**SOMAR SPECIALTY CORP.**

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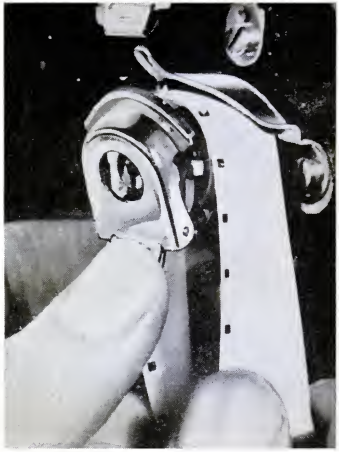
*PAT. PENDING

## Makes Films Last Longer

MOVIE-SPROCKET, roller and guide wear are liable to scratch films carried through projectors. Bell & Howell Co. tackle the problem with projectors equipped with specially designed sprockets and rollers that do not permit the picture area or sound track of the film to touch any stationary or metal parts as it goes through the machine. The only metal that comes in contact with the film is outside the picture area.

## Button-Sized Battery

A MIDGET dry-battery cell, used by the U. S. Signal Corps to power the handie-talkie, is being manufactured for commercial use by P. R. Mallory, Inc., Indianapolis. A bit more than one third as large as an ordinary small-sized flashlight battery, this dry cell is one inch in diameter by ⅝ inch high. Compared size for size, the Mallory cell's ampere-hour capacity is four to six times greater than that of the usual commercial dry cell.

# FORD'S OUT FRONT in style, too!

The Big New 1946 Ford Sedan Coupe

Whatever model you choose, the big new 1946 Ford car is a streamlined beauty from the newly styled grille to the rugged rear bumper! And there's refreshing new elegance inside, too. Rich fabrics! Restful seats! A new instrument panel, smartly decorated with plastic trim! For performance, Ford is the only car in the low-priced field with 100 horsepower, the only car with 8 cylinders . . . the only car with a V-type engine (the kind used in America's costliest cars) . . . the only car that gives you the safety of such big oversized, self-centering hydraulic brakes! See it at your Ford dealer's.

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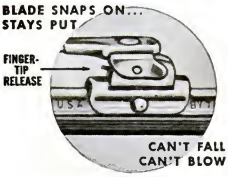
## "Dead-Locker"
**WINDSHIELD WIPER ARMS and BLADES**

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**DON'T SHOOT YOUR GAS-PUMP MAN!**

He's doing the best he can. Sure, he knows how dangerous it is for you to drive your car... in stormy weather... with your dull old windshield wipers that smear and smear. He'd gladly put on for you quickly a pair of keen new ANCO RAIN-MASTER Wiper Blades and Arms. He has them—Newest Models! But he forgets to remind you? Too busy? You can't shoot him for that!

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Ask for RAIN-MASTER Windshield Wiper Arms and Blades next time you buy gas.

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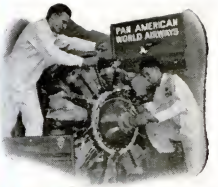
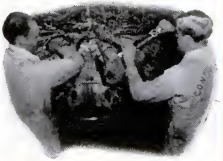



PAN AMERICAN

UNITED

TRANS-CANADA

PENNSYLVANIA CENTRAL



CONTINENTAL

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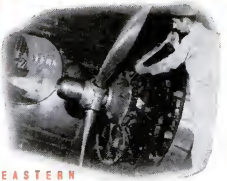
BRANIFF

AMERICAN



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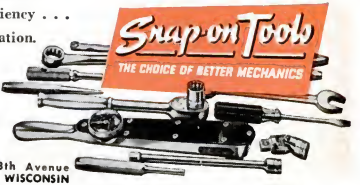


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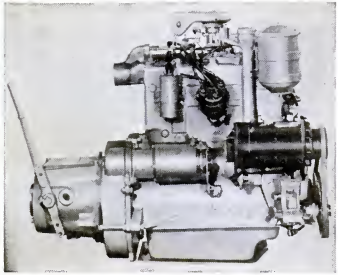
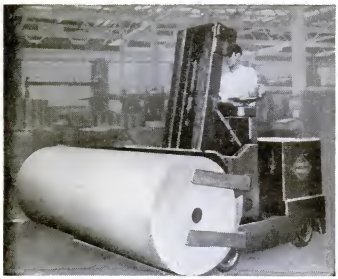


## Jeep Power for Marine Use

CONVERSION of the Willys jeep motor into an inboard marine engine has been made possible by equipment manufactured by Osco Motors Corp., Philadelphia. Already being used for farm power, generators, pumps, etc., the motor may now be adapted to launches and other auxiliary boats. No special tools are required for installation, and no machine work is needed. Marine gear provides one speed forward, one reverse.



## Versatile Power Handler

LONG CYLINDRICAL objects such as rolls of newsprint paper, weighing as much as two tons, can be easily and efficiently handled by power trucks developed by Elwell-Parker Electric Co., Cleveland, Ohio. The battery-driven truck has various attachments designed for gripping and manipulating its load. A rotating device enables the operator to transport, pick up or put down a roll with equal facility in either a vertical or horizontal position. By means of an elevation mechanism, he can raise the roll for stacking horizontally or to remove it from a stack of rolls. The truck cradle is adjustable to various diameters of loads.

COMFORT UNLIMITED—that's what you'll get when your home is equipped with Honeywell's remarkable new heating control system. It is called MODUFLOW*.

And, "Comfort Unlimited" is the title of Honeywell's brand new booklet that tells all about Moduflow. Attractively illustrated in color, it is both interesting to read and easy to understand. Discover how Moduflow eliminates the up-and-down temperatures of ordinary on-or-off heating systems; how it reduces wasteful overheating at the ceiling and eliminates the unhealthful drafts and cold floors caused by intermittent heat supply.

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Best of all, learn how Moduflow can be easily and inexpensively installed on your present automatic heating system. You don't have to wait until you build a new home.

All of this, and more, is told in this fascinating booklet. Whether you are planning to build, or modernize your present heating system, you should investigate Moduflow. So, mail the coupon today, for your free copy.

* MODUFLOW is the name of Honeywell's newest heating control system. It means *modulated* heat with a continuous *flow*. Moduflow will be a "must" in the better homes and apartments of tomorrow.

# MODUFLOW

**the new HONEYWELL heating control system**

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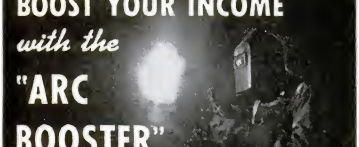

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Refrigerators, mixers, motors, power tools, lawn mowers, ironers.

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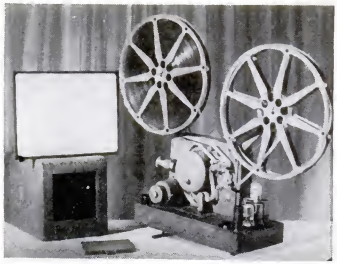
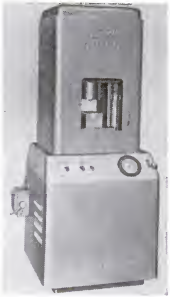


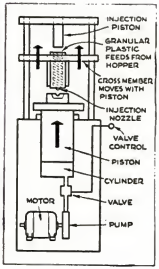
## Compact Talkie Projector

SLIGHTLY larger, packed, than a portable typewriter, a 16-mm. sound-on-film projector called the Movie-Mite Model 63-L has made its appearance. The whole outfit, with everything necessary to put on a show, weighs 27½ pounds. It can be unpacked, completely set up, threaded, and "on the screen" inside of three minutes. Both projector and amplifier operate on either A.C. or D.C. A centrifugal blower cools operation.

## Plastic Machine In Small Unit



A SMALL and relatively low-cost injection-molding machine has recently been developed by Sav-Way Industries, Detroit. It has a 20-ton capacity and a mold-casting area of four square inches, for about two ounces of plastic material, which may embrace all the thermoplastics, including polystyrene, cellulose acetate and the vinyl resins. Electric heating elements control temperature up to 600 F., and the motor-powered hydraulic system gives line pressure up to 2,000 pounds per square inch.



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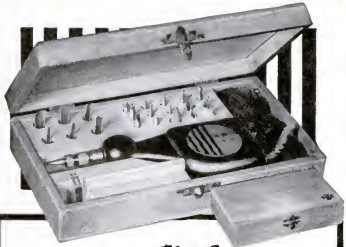

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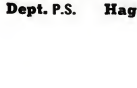


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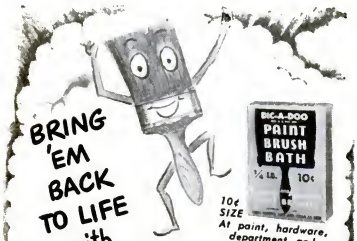


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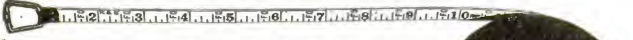

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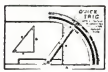


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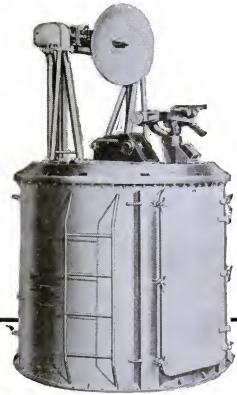

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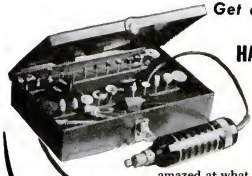

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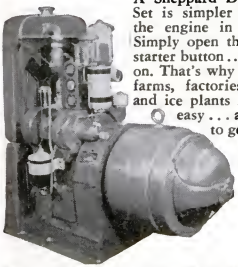

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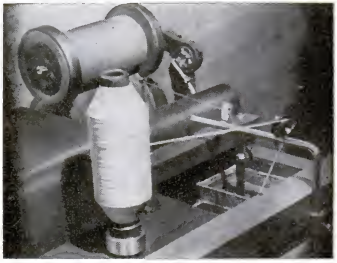

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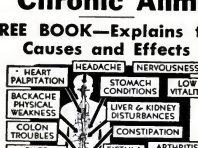


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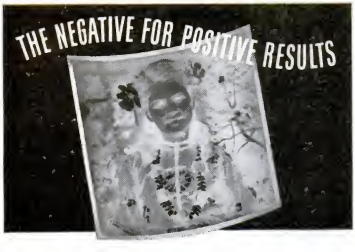


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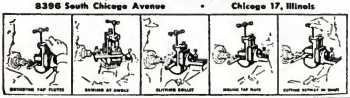


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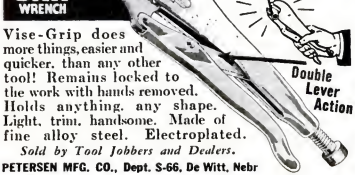


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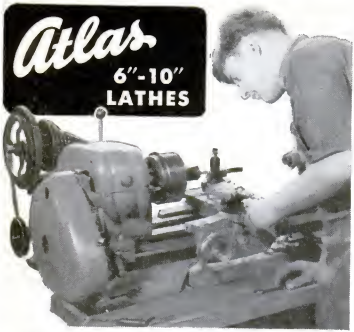

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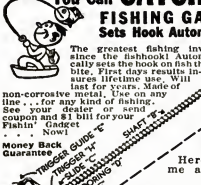


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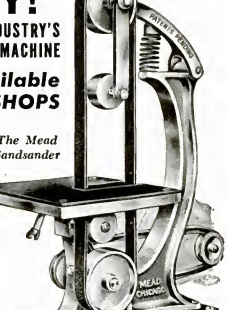


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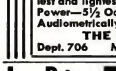

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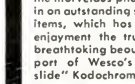


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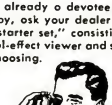

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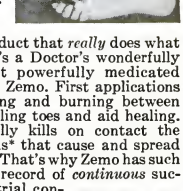

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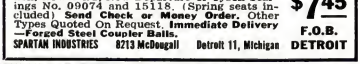

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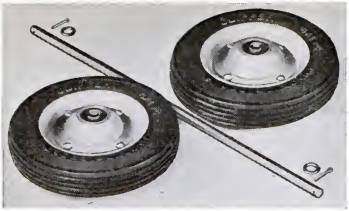

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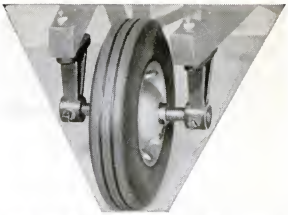

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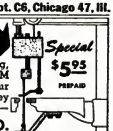

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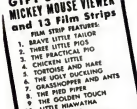

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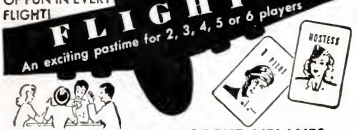


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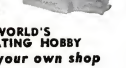

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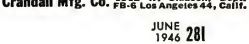


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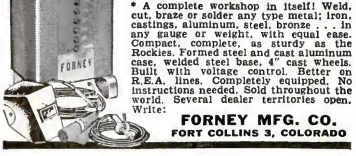


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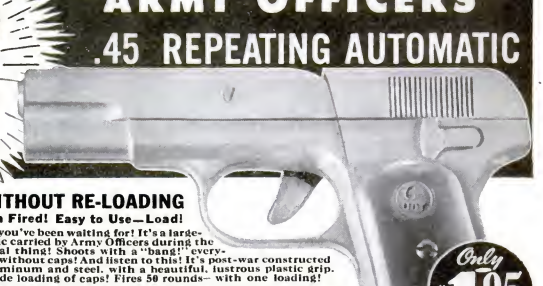

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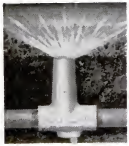

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TO: Reader
FROM: Editor

# PS Men *get around*

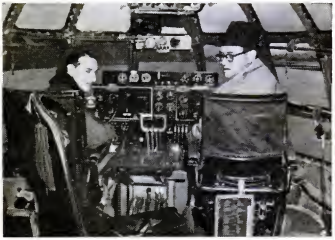
THE Editor's Easy Chair at *Popular Science Monthly* is a varied seat. It may be a lounge chair in a new air liner or the hard, cold metal "bucket" of a military transport, a Pullman bedroom or standing room in a day coach on an early train. Sometimes it is a swivel chair in the editorial offices. But since PSM's kind of journalism calls for getting within touching distance of ideas, our editors never let their office chairs get too warm.

This see-for-yourself policy goes for the men at the top of the masthead as well as for us who are reporter-editors. I speak with some feeling, having just returned from a 16-day trip with Editor Perry Githens that has left me with my tongue down on my necktie. I went along for the ride, I thought, but soon found I had to work my passage. Because Githens is the kind of person who wants more of everything. He wants to meet more people, see more things. That big,

SAN FRANCISCO . . . with *Chronicle's* Paul C. Smith.

gray sponge behind his spectacles is always thirsty for more information and experience.

With Andrew R. Boone, PSM's Western Editor, we looked and listened from San Diego to Los Angeles. Then Githens and I went on to San Francisco and Seattle. Githens walked miles through the Coast's huge aircraft factories. He talked with company heads and engineers about the future of aviation and supersonic planes. He discussed scientific education with some of the world's most distinguished scientists and teachers at California Institute of Technology. He hoisted his not inconsiderable bulk into the cockpit of the Army's new Northrop Flying



SEATTLE . . . . with Boeing's Pilot Ernie Code.

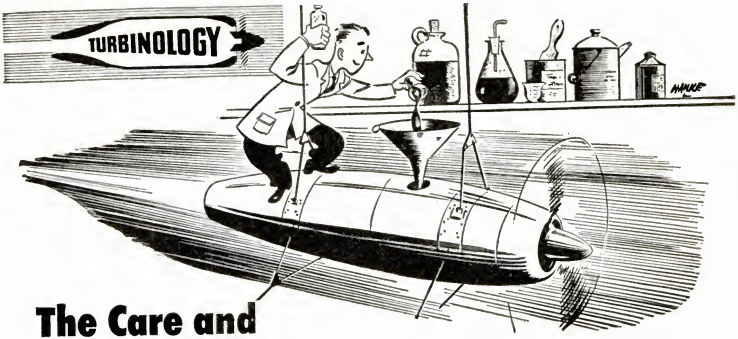
Wing bomber you saw described in our May issue. He was like that hungry dog in a butcher shop as we went through the Douglas plant and the Lockheed research laboratories. He was properly awed in the frightening twilight inside the world's biggest wind tunnel at the Ames Laboratory of the National Advisory Committee for Aeronautics at Moffett Field, south of San Francisco. He was properly appreciative, having dabbled in movies himself, when we visited the Columbia lot where William Wellman, an old schoolmate, was shooting the story of the Montgomery brothers, glider pioneers, while DC-3s noised overhead. In San Francisco, he lunched with Chronicle Editor Paul C. Smith in his house on Telegraph Hill, then spent a day on foot soaking up the sights and sounds of that city.

When we got back, I figured we had clocked up some 7,514 miles by air, rail, motor and shoe leather. This gives Githens a total of 16,650 miles for the first four months of the year, which makes him temporary traveling champ of the staff.

Such getting around takes time and money, but Publisher Hammond and Editor Githens don't believe in mailbag-and-scissors editing. They think PSM should make you feel you were there.

Daisy Frances

This One
WQ45-5W4-FWNE




# The Care and Feeding of a Turbine

The new propeller turbine of the Wright Aeronautical Corporation is no gourmet with a choosey appetite. It would be possible, though not very practical, to design it to run on either gasoline, kerosene, fuel oil, alcohol, cleaning fluid, or paint remover.

These liquids burn easily. And the main problem in "feeding" a turbine is to give it a free-burning fuel that produces intense heat to expand air and thus put enough pressure on the turbine blades to force them to turn.

If the turbine was for ground use, the cheapest fuel might be selected, fuel oil or crude oil. But in the air, every pound of fuel means one less pound of potential payload. So the fuel with the highest heat value for the lowest weight has to be selected.

MORE FUEL THAN LOAD

Otherwise, planes would be like trains a century ago, when they carried so much firewood there was scant room for passengers.

Years ago, scientists measured the heat necessary to raise the temperature of a pound of water one degree Fahrenheit. They called this a British thermal unit. It is a very critical measure of fuel value. This is the way three common fuels rate in B.t.u.'s per pound: Dry wood 5,000, Coal 14,000, Gasoline 19,000.

Kerosene and fuel oil have about the same number of B.t.u.'s per pound as gasoline. Uranium has millions per pound but no one knows yet how to pour it into a fuel tank.

Kerosene is a promising turbine fuel. In cold weather, it flows easily, and doesn't "boil" or vaporize at high altitude as gasoline will. Since there is no "knock" problem in a turbine, it doesn't matter that kerosene has an octane rating far below gasoline.

However, gasoline is being used in the experimental models for several reasons. It is plentiful. From long experience with Cyclones, Wright engineers are skilled in metering gasoline and designing air intakes and combustion chambers to get just the right combination of air and fuel for best heat results. Finally, there is less carbon, a serious problem on the delicately balanced turbine blades.

Yet if you should visit the Wright Aeronautical test cells in the coming months, you might see turbines being tested with gasoline, kerosene, fuel oil, or maybe mixtures of the three.

Eventually, Wright engineers will select one fuel to burn in the production models of the turbines. In line with their long practice of building more power with less weight and less fuel consumption, that fuel will be the one which will permit giant airliners to get the utmost in turbine power and still carry a maximum load in passengers, mail and cargo.

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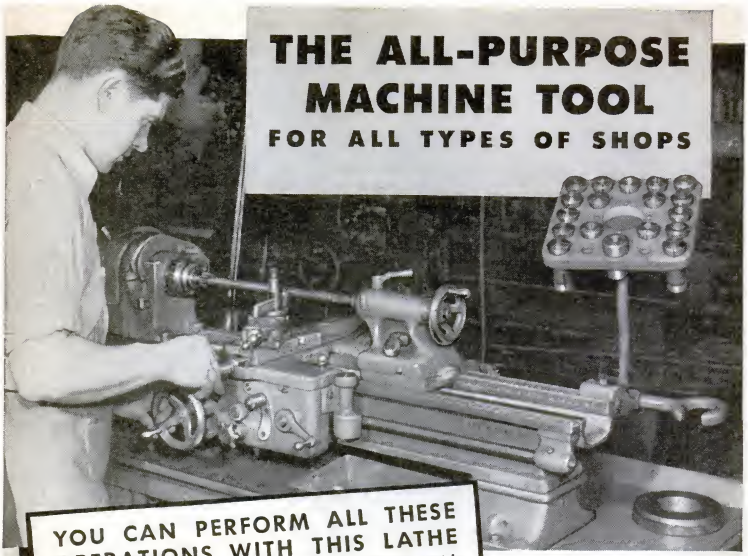

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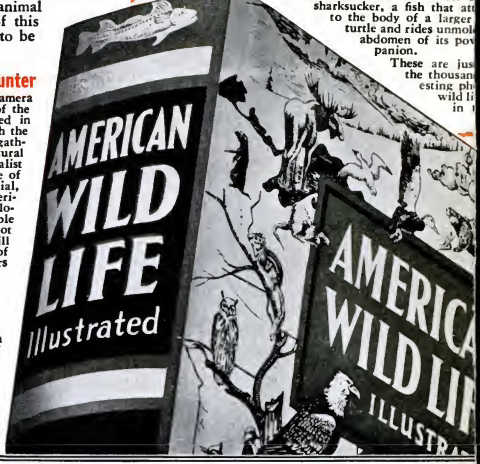


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